EXCEL ENGINEERING COLLEGE
(Autonomous)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NBA and NAAC with "A+"and Recognized by UGC(2f&12B)
KOMARAPALAYAM - 637303

DEPARTMENT OF MECHANICAL ENGINEERING

FOURTH BOARD OF STUDIES

MINUTES OF MEETING

Meeting No : EEC/MECH/BoS/4
Date : 28.03.2023
Time : 10.00 AM
Venue : TVR Hall

Agenda:

B.ME.4.1. To discuss and pass the syllabus of VII Semester to B.E Mechanical engineering programme for the students admitted from the academic year 2020 – 21 onwards under Regulation 2020.

B.ME.4.2. To discuss and pass the courses for B.E.(Honours) specialisation in the same discipline and B.E.(Honours) for the students admitted from the academic year 2021-22 onwards under Regulation 2020/ V2

B.ME.4.3. To discuss and pass the curriculum and syllabi of Minor Degree programme in Automotive Engineeirng for the students admitted from the academic year 2021 – 22 onwards under Regulation 2020 / V2.

B.ME.4.4. To discuss and pass the curriculum of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023.

B.ME.4.5. To discuss and pass the First Semester syllabi of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023.

B.ME.4.6. To discuss and pass the second year syllabi of M.E Thermal engineering for the students admitted from the academic year 2022 – 23 onwards under Regulation 2022.

B.ME.4.7. Any other matters.

Resolutions

B.ME.R.4.1 It is resolved that the syllabus of VII Semester to B.E Mechanical engineering programme for the students admitted from the academic year 2020 – 21 onwards under Regulation 2020 may be passed with the following changes.

Semester- VII

RECOMMENDATION	RESOLUTION
B.ME.4.1.1 Dr.PL.K.Palaniappan suggested to verify and change the Bloom's level for all units.	**B.ME.R. 4.1.1** Bloom's level have been verified and changed as per suggestion
B.ME.4.1.2 Dr.M.Saravanakumar insisted to include the additional references and web links.	**B.ME.R. 4.1.2** The additional references and web links are incorporated as per the suggestion.
B.ME.4.1.3 Dr.M.Saravanakumar insisted to include the information security policy and protocols in Unit IV.	**B.ME.4.1.3** The information security policy and protocols in Unit IV are incorporated as per the suggestion.
B.ME.4.1.4 Dr. R. Robinson Smart recommended to include the topic for legal issue for registration of new company	**B.ME.4.1.4** The topics for legal issue for registration of new company incorporated as per the suggestion.
B.ME.4.1.5 Dr.PL.K.Palaniappan suggested to verify the allocation of mark and weightage in TQM Subject.	**B.ME.4.1.5** The allocation of mark and weightage in TQM Subject verified and changed as per suggestion.
B.ME.4.1.6 Dr.M.Saravanakumar recommended to include the topic 8D and FT Analysis in Unit V.	**B.ME.4.1.6** The topics 8D and FT Analysis in Unit V. is Included as per recommendation.
B.ME.4.1.7 Dr.M.Saravanakumar insisted to change the topic safety and security protocol instead of safety protocol.	**B.ME.R. 4.1.7** the title safety and security protocol has been changed as per suggestion
B.ME.4.1.8 Dr.M.Saravanakumar suggested to include the topic NABL in the Syllabus Total Quality Management	**B.ME.R. 4.1.8** As per suggestion the topic NABL were included in the syllabus Total Quality Management
B.ME.4.1.9 Dr.M.Saravanakumar recommended to include the industrial psychology and organizational behavior in the professional ethics syllabus Unit - IV	**B.ME.R. 4.1.9** As per the suggestion the industrial psychology and organizational behavior in the professional ethics syllabus Unit – IV were incorporated

B.ME.R.4.2 It is resolved to pass the courses for B.E.(Honours) specialisation in the same discipline and B.E.(Honours) for the students admitted from the academic year 2021-22 onwards under Regulation 2020/ V2.

B.ME.R.4.3 it is resolved to pass the curriculum and syllabi of Minor Degree programme in Automotive Engineering for the students admitted from the academic year 2021 – 22 onwards under Regulation 2020 / V2 with the following changes.

B.ME.4.3.1 Dr.P.L.K.Palaniyappan suggested that the subject fundamentals of automotive title may be changed to Evolution of automotives	**B.ME.R.4.3.1** It is resolved as per suggestion from Dr.P.L.K.Palaniyappan that the subject fundamentals of automotive has been changed to Evolution of automotives

B.ME.R.4.4. it is resolved to pass the curriculum of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023 with the following changes.

B.ME.4.4.1 Mr. K.K. Tamilarasan recommended to modify the subject automotive materials design and testing into automotive materials and testing	**B.ME.R.4.4.1** As per recommendations the subject title were modified into automotive materials and testing

B.ME.R.4.5 it is resolved to pass the First Semester syllabi of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023 with the following changes.

B.ME.4.5.1 Dr.P.L.K.Palaniyappan recommended to modify the contents in Unit –III Power plant engineering	**B.ME.R.4.5.1** As per recommendations the contents were modified in Unit –III Power plant engineering

B.ME.R.4.6 it is resolved to pass the third semester syllabi of M.E Thermal engineering for the students admitted from the academic year 2022 – 23 onwards under Regulation 2022.

It is resolved that all the revisions and recommendation has been incorporated in the curriculum and syllabus

28/03/2023
University Nominee

(Dr. D.S. Robinson Smart)
28/3/2023
Academic Expert

28/Mar/2023
CM. Saravanakumar
Industry Expert

Chairman - Board of Studies

28/03/23
Principal

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KOMARAPALAYAM – 637303

FOURTH BOARD OF STUDIES MEETING

Members list

S.No	Name and Affiliation	Designation
1.	Dr.PL.K.Palaniappan Professor Mechanical Engineering Thiyagarajar College of Engineering Madurai- 625015 Mobile No 9443463523	University Nominee
2.	Dr.J.Jerald Associate Professor Department of Production Engineering National Institute of Technology, Tiruchirappalli Tamilnadu, India. 620015 Mobile No 9442530103	Academic Expert
3.	Dr.R.Robinson Smart Professor, (Design) Engineering, Karunya University Karunya Nagar Coimbatore 641114 Mobile No 9787334463	Academic Expert
4.	Mr.N.Lakshminarasimhan General Manager-HR, Brakes India Limited, Padi,Chennai.600050 Mobile No 9786662031	Industry Expert
5.	Dr.M.Saravanakumar Senior Manager- Mechanical Validation Robert Bosch Engineering Solutions Pvt lmtd, Coimbatore. Mobile No 9894762214	Industry Expert
6.	Mr.K.K.Tamilarasan Manager – HR Sakthi Auto Components Pvt Ltd Perundurai. Mobile No 9443739218	Industry Expert

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FOURTH BOARD OF STUDIES MEETING

Attendance

Date 28/3/23

S.No	Name and Affiliation	Designation	Signature
1.	Dr.P.L.K.Palaniappan Professor Mechanical Engineering Thiyagarajar College of Engineering Madurai- 625015 Mobile No 9443463523	University Nominee	
2.	Dr.J.Jerald Associate Professor Department of Production Engineering National Institute of Technology, Tiruchirappalli Tamilnadu, India. 620015 Mobile No 9442530103	Academic Expert	ABSENT
3.	Dr.R.Robinson Smart Professor, (Design) Engineering, Karunya University Karunya Nagar Coimbatore 641114 Mobile No 9787334463	Academic Expert	28/3/2023
4.	Mr.N.Lakshminarasimhan General Manager-HR, Brakes India Limited, Padi,Chennai.600050 Mobile No 9786662031	Industry Expert	ABSENT
5.	Dr.M.Saravanakumar Senior Manager- Mechanical Validation Robert Bosch Engineering Solutions Pvt lmtd, Coimbatore. Mobile No 9894762214	Industry Expert	
6.	Mr.K.K.Tamilarasan Manager – HR Sakthi Auto Components Pvt Ltd Perundurai. Mobile No 9443739218	Industry Expert	

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FOURTH BOARD OF STUDIES MEETING

Faculty Members

Date : 2/3/23

S. No.	Name	Designation	Signature
1.	Dr.N.Natarajan	Professor	
2.	Dr.N.Venkatachalam	Associate Professor	
3.	Dr. K.Boopathy	Associate Professor	
4.	Dr.R.Vinoth	Associate Professor	
5.	Dr. N.Tamilselvan	Associate Professor	
6.	Mr.S.S.Jayaraman	Assistant Professor	
7.	Mr.S.Nirmalkumar	Assistant Professor	
8.	Mr.V.Shanthamoorthy	Assistant Professor	
9.	Mr.K.Yuvaraj	Assistant Professor	AB
10.	Mr.K.Yuvaraj (Bhavani)	Assistant Professor	
11.	Mr.M.Srikanth	Assistant Professor	AB
12.	Mr.D.Alagesan	Assistant Professor	
13.	Mr.P.Praveen	Assistant Professor	
14.	Mr.V.Karthikeyan	Assistant Professor	
15.	Mr.T.M Sakthi Muruga	Assistant Professor	
16.	Mr.Sambath Kumar	Assistant Professor	
17.	Mr.M.Nandhakumar	Assistant Professor	
18.	Mr.N.Prithviraj	Assistant Professor	
19.	Mr.V.Udhayakumar	Assistant Professor	AB
20.	Mr.T.Mohanasundaram	Assistant Professor	

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FOURTH BOARD OF STUDIES MEETING

21.	Mr.V.Prasanna Kumar	Assistant Professor	22/6/22
22.	Mr.S.Anandhakumar	Assistant Professor	
23.	Mr.M.Dineshkumar	Assistant Professor	AB
24.	Mr. N.Selvakumar	Assistant Professor	
25.	Dr.S.Balakrishnan	Assistant Professor	AB
26.	Mr.D.S Gokulraj	Assistant Professor	
27.	Mr.R.Premraj	Assistant Professor	
28.	Mr.P.Nithyanand	Assistant Professor	
29.	Mr. S.Ganapathy	Assistant Professor	
30.	Mr. M.Karthick	Assistant Professor	
31.	Mr. P.Jagadeeshwaran	Assistant Professor	AB
32.	Mr. S.Jeromeignatius	Assistant Professor	AB
33.	Mr. G.Malarkannan	Assistant Professor	
34.	Mr. G.Ramamoorthy	Assistant Professor	

08-12-2023

FIFTH BOARD OF STUDIES MEETING

Meeting No : EEC/Autonomous/2023-24/Mech/BOS/05
Date : 18.12.2023 (Monday)
Time : 10.00 AM
Venue : Conference Room – Hyundai Professional Development Center

Agenda:

B.ME.5.1 To discuss and pass the syllabus of VIII Semester B.E Mechanical engineering programme for the students admitted from the academic year 2020 – 21 onwards under Regulation 2020.

B.ME.5.2 To discuss and pass the curriculum and syllabi of Minor Degree programme in Automotive Technology for the students admitted from the academic year 2021 – 22 onwards under Regulation 2020 / V2.

B.ME.5.3 To discuss and pass the revised curriculum of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023.

B.ME.5.4 To discuss and pass the first year second semester syllabi of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023.

B.ME.5.5 To discuss and pass the second year fourth semester syllabi of M.E Thermal engineering for the students admitted from the academic year 2022 – 23 onwards under Regulation 2022.

B.ME.5.6 Any other matters.

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CHAIRMAN - BOARD OF STUDIES

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KOMARAPALAYAM – 637303

FIFTH BOARD OF STUDIES

Members

S.No	Details	Category	Name and Designation of the Member
1.	Chairman	Head of the Department	**Dr.M.Kathiresan** Professor & Head, Department of Mechanical Engineering Excel Engineering College
2.	Two subject experts from outside the Parent University to be nominated by the Academic Council	Academic Expert – 01	**Dr.M.R.Rajamanickam** Associate Professor, Department of Mechanical Engineering, Annamalai University, Chidambaram. Mobile: +91 94425 38447 E-Mail : mrrmanickam@yahoo.co.in
3.		Academic Expert – 02	**Dr. R. Senthil** Associate Professor Department of Mechanical Engineering. SRM Institute of Science and Technology, Chennai. Mail: senthilr@srmist.edu.in, Mobile: 9841178117
4.	One expert to be nominated by the Vice-Chancellor from a panel of six recommended by the college principal.	University Nominee	**Dr.M.Mohanraj** Associate Professor Department of Mechanical Engineering Government college of engineering, Salem – 636 011. Mobile: 9789624699 Mail: mohanraj.cad@gmail.com
5.	Representative from industry/corporate sector/allied area relating to placement	Industry Expert – 01	**Mr.J.Mohammed Aashiq** Managing Director JK Industries (P) Ltd, 10/13-B, Ammankulam Road, Pappanaickenpalayam (PO),Coimbatore-37. Mobile: +91 8825986880 Mail: jkindustries1990@gmail.com
6.		Industry Expert – 02	**Mr.K.K.Tamilarasan** Manager – HR Sakthi Auto Components Pvt Ltd Perundurai. Mobile : 9443739218 Mail : tamilrasan.kk@sakthiauto.com
7.	Meritorious alumnus to be nominated by the principal. The Chairman, Board of Studies, may with the approval of the principal of the college, co-opt:	UG – Alumni	**R.Rojakannan** Software Engineer - Mechanical Actalent Pvt Limited Slarpuria Arena,6th Floor, No- 24 Hosur Road, Banglore, Karnataka-560029 Mobile: 8870889419 Mail: rojakannanmech@gmail.com 2012-16 Batch

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CHAIRMAN - BOARD OF STUDIES

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DEPARTMENT OF MECHANICAL ENGINEERING

FIFTH BOARD OF STUDIES

MINUTES OF MEETING

Meeting No : EEC/MECH/BoS/05
Date : 18.12.2023
Time : 10.00 am
Venue : Hyundai Professional Development Center

Agenda:

B.ME.5.1 To discuss and pass the syllabus of VIII Semester B.E Mechanical engineering programme for the students admitted from the academic year 2020 – 21 onwards under Regulation 2020.

B.ME.5.2 To discuss and pass the curriculum and syllabi of Minor Degree programme in Automotive Technology for the students admitted from the academic year 2021 – 22 onwards under Regulation 2020 / V2.

B.ME.5.3 To discuss and pass the revised curriculum of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023.

B.ME.5.4 To discuss and pass the first year second semester syllabi of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023.

B.ME.5.5 To discuss and pass the second year fourth semester syllabi of M.E Thermal engineering for the students admitted from the academic year 2022 – 23 onwards under Regulation 2022.

B.ME.5.6 Any other matters.

Resolutions

B.ME.5.1 To discuss and pass the syllabus of VIII Semester B.E Mechanical engineering programme for the students admitted from the academic year 2020 – 21 onwards under Regulation 2020.

B.ME.R.5.1 It is resolved that the following recommendations for VIII Semester B.E Mechanical engineering programme for the students admitted from the academic year 2020 – 21 onwards under Regulation 2020 were incorporated.

Recommendations	Resolutions
B.ME.5.1.1 Dr.M.Mohanraj and Dr.R.Senthil recommended to revise the project contact hours and allocation of project team members	**B.ME.R.5.1.1** Recommendations has been carried out as per suggestions in the project contact hours and allocation of project team members

B.ME.5.2 To discuss and pass the curriculum and syllabi of Minor Degree programme in Automotive Technology for the students admitted from the academic year 2021 – 22 onwards under Regulation 2020 / V2.

B.ME.R.5.2 it is resolved that the following recommendations for the curriculum and syllabi of Minor Degree programme in Automotive Technology for the students admitted from the academic year 2021 – 22 onwards under Regulation 2020 / V2 has been conceded.

Recommendations	Resolutions
B.ME.5.2.1 Dr.R.Senthil suggested to change the 20MEM04 - Maintenance of Automotive Unit V title to Pre delivery inspection	**B.ME.R.5.2.1** it is resolved that the title for Unit – V in the 20MEM04 has been changed as per suggestions

B.ME.5.3 To discuss and pass the revised curriculum of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023.

B.ME.R.5.3 It is resolved that the following recommendations for the revised curriculum of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023 were incorporated.

Recommendations	Resolutions
B.ME.5.3.1 Dr.M.Mohanraj recommended that 1.23ENE02- Advanced Communication English - Subject title and Code can be revised 2.23ME301- Credits can be reconsidered 3.23ME603- Mechatronics and IOT – Name can be revised with core mechatronics 4.23ME701 – Entrepreneurship Development and Professional Ethics can be splitted into individual subjects 5. 23MEA07 – Subject title can revised to	**B.ME.R.5.3.1** it is resolved that the followings recommendations has been incorporated 1.23ENE02- Advanced Communication English - Subject title and Code revision suggested to Science and Humanities Board 2.23ME301- Credits has been revised 3.23ME603- Mechatronics and IOT – Name revised with core name 4.23ME701 – Recommendations forwarded to Academic Council

vehicle trouble shooting testing.	5. 23MEA07 – Subject title has been changed to Vehicle trouble shooting testing.
B.ME.5.3.2 Dr.R.Senthil suggested the following recommendations 1. 23ME401 – Credits can revised 2. 23ME602 – Subject title can be revised to finite element analysis 3. 23ME607 – In internship evaluation methods can be incorporated with internal mode of evaluation	**B.ME.R.5.3.2** it is resolved that the followings suggestions has been carried out 1. 23ME401 – Credits has been revised 2. 23ME602 – Subject title revised to finite element analysis 3. 23ME607 – Evaluation methods for the internship with internal mode of evaluation has been forwarded to Academic Council
B.ME.5.3.3 Dr.M.R.Rajamanickam Recommended to equalize the technology based subjects in 4th, 5th, 6th and 7th semester and the suggested to revise the credits for the subjects 23ME501 & 23ME502	**B.ME.5.3.4** it is resolved that the Recommendation to equalize the technology based subjects in 4th, 5th, 6th and 7th semester has been carried out and the suggestion to revise the credits for the subjects 23ME501 & 23ME502 were incorporated

B.ME.5.4 To discuss and pass the first year second semester syllabi of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023.

B.ME.R.5.4 It is resolved that the recommendations for first year second semester syllabi of B.E Mechanical engineering for the students admitted from the academic year 2023 – 24 onwards under Regulation 2023 has been incorporated.

Recommendations	Resolutions
B.ME.5.4.1 Dr.M.Mohanraj and Dr.R.Senthil recommended to include Molding process, Fitting of Pipelines, Drilling and Tapping in the 23ME202 – Mechanical Engineering Practices Laboratory	**B.ME.R.5.4.1** Recommendations to include Molding process, Fitting of Pipelines, Drilling and Tapping in the 23ME202 – Mechanical Engineering Practices Laboratory has been carried out as per suggestions.

B.ME.5.5 To discuss and pass the second year fourth semester syllabi of M.E Thermal engineering for the students admitted from the academic year 2022 – 23 onwards under Regulation 2022.

B.ME.R.5.5 It is resolved that the recommendations for second year fourth semester syllabi of M.E Thermal engineering for the students admitted from the academic year 2022 – 23 onwards under Regulation 2022 has been carried out.

B.ME.5.6

BR.ME.5.6 – It is resolved that all the recommendations and the revisions has been carried out as per suggestions.

18/12/23	18/12/2023	18.12.2023
University Nominee	Academic Expert 01	Academic Expert 02
18/12/2023	—	—
Industry Expert 01	Industry Expert 02	Alumni

EXCEL ENGINEERING COLLEGE
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Komarapalayam

18/12/23

Chairman - Board of Studies

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KOMARAPALAYAM – 637303

FIFTH BOARD OF STUDIES

Member Present

Date: 18.12.2023

S.No	Name and Designation of the Member	Category	Signature
1.	**Dr.M.Kathiresan** Professor & Head, Department of Mechanical Engineering Excel Engineering College	Head of the Department	18/12/23
2.	**Dr.M.R.Rajamanickam** Associate Professor, Department of Mechanical Engineering, Annamalai University, Chidambaram.	Academic Expert – 01	18/12/2023
3.	**Dr. R. Senthil** Associate Professor Department of Mechanical Engineering. SRM Institute of Science and Technology, Chennai.	Academic Expert – 02	18.12.2023
4.	**Dr.M.Mohanraj** Associate Professor Department of Mechanical Engineering Government college of engineering, Salem – 636 011.	University Nominee	18/12/23
5.	**Mr.J.Mohammed Aashiq** Managing Director JK Industries (P) Ltd, 10/13-B, Ammankulam Road, Pappanaickenpalayam (PO),Coimbatore-37.	Industry Expert – 01	18/12/2023
6.	**Mr.K.K.Tamilarasan** Manager – HR Sakthi Auto Components Pvt Ltd Perundurai.	Industry Expert – 02	← ABSENT →
7.	**R.Rojakannan** Software Engineer - Mechanical Actalent Pvt Limited Hosur Road, Banglore, Karnataka-560029	UG – Alumni	← ABSENT →

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FIFTH BOARD OF STUDIES

S.No	Name	Designation	Signature
1.	Dr.R.Vinoth	Associate Professor	
2.	Dr.E.R. Sivakumar	Associate Professor	ABSENT
3.	Dr. N.Tamilselvan	Assistant Professor	ABSENT
4.	Dr.N.Venkatachalam	Associate Professor	
5.	Dr. M Venkatesan	Assistant Professor	ABSENT
6.	Mr.S.S.Jayaraman	Assistant Professor	
7.	Mr.Sambath Kumar	Assistant Professor	ABSENT
8.	Mr.V.Karthikeyan	Assistant Professor	
9.	Mr.P.Nithyanand	Assistant Professor	
10.	Mr.T.M Sakthi Muruga	Assistant Professor	
11.	Mr.M.Nandhakumar	Assistant Professor	
12.	Mr.D.Alagesan	Assistant Professor	
13.	Mr.M.Dineshkumar	Assistant Professor	
14.	Mr. N.Selvakumar	Assistant Professor	
15.	Mr.V.Udhayakumar	Assistant Professor	
16.	Mrs.K.K.Megavarthini	Assistant Professor	
17.	Mr.R.Premraj	Assistant Professor	ABSENT

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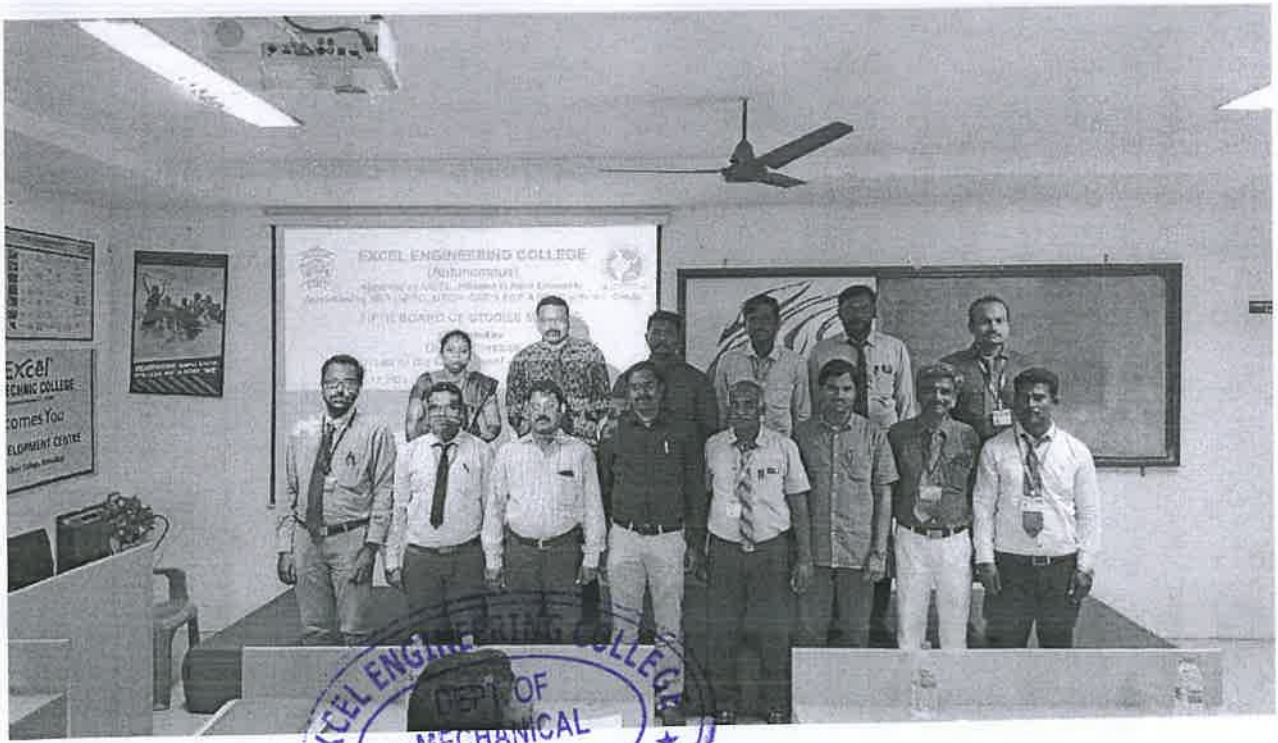
Images



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B.E. MECHANICAL ENGINEERING
REGULATION – 2020
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULUM AND SYLLABI

I SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
20MA105	Mathematics – I for Mechanical Sciences	BS	3	2	0	4	40	60	100
20EC103	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	40	60	100
20ME102	Fundamentals of Mechanical Engineering	PC	3	0	0	3	40	60	100
Theory with Practical Course(s)									
20ENEXX	Language Elective – I	HSS	2	0	2	3	50	50	100
20CH103	Chemistry for Mechanical Sciences	BS	3	0	2	4	50	50	100
20ME101	Engineering Graphics	ES	1	0	4	3	50	50	100
Mandatory Course									
20MC101	Induction Programme	MC	2 Weeks			0	100	-	100
TOTAL			**15**	**2**	**8**	**20**	**370**	**330**	**700**

Language Electives – I									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20ENE01	Communicative English	HSS	2	0	2	3	50	50	100
20ENE02	Advanced Communicative English	HSS	2	0	2	3	50	50	100

IISEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
20MA205	Mathematics – II for Mechanical Sciences	BS	3	2	0	4	40	60	100
20ME201	Engineering Mechanics	ES	3	2	0	4	40	60	100
Theory with Practical Course(s)									
20ENEXX	Language Elective – II	HSS	2	0	2	3	50	50	100
20PH203	Physics for Mechanical Sciences	BS	3	0	2	4	50	50	100
20CS201	Problem Solving using Python	ES	3	0	2	4	50	50	100
Practical Course(s)									
20ME202	Mechanical Engineering Practices Laboratory	ES	0	0	2	1	50	50	100
Mandatory Course									
20MC201	Environmental Sciences	MC	2	0	0	0	100	-	100
Total			**16**	**4**	**8**	**20**	**380**	**320**	**700**

Language Electives – II									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
20ENE02	Advanced Communicative English	HSS	2	0	2	3	50	50	100
20ENE03	Hindi	HSS	2	0	2	3	50	50	100
20ENE04	French	HSS	2	0	2	3	50	50	100
20ENE05	German	HSS	2	0	2	3	50	50	100

III SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
20MA301	Transforms and Boundary Value Problems	BS	3	2	0	4	40	60	100
20ME302	Engineering Thermodynamics	ES	3	2	0	4	40	60	100

20ME302	Engineering Materials and Metallurgy	PC	3	0	0	3	40	60	100
20ME303	Fluid Mechanics and Machinery	PC	3	0	0	3	40	60	100
20ME304	Kinematics of Machinery	PC	3	0	0	3	40	60	100
Theory with Practical Course(s)									
20ME305	Manufacturing Technology – I	PC	3	0	2	4	50	50	100
Practical Course(s)									
20ME306	Computer Aided Machine Drawing Laboratory	PC	0	0	2	1	50	50	100
20ME307	Fluid Mechanics and strength of materials laboratory	PC	0	0	2	1	50	50	100
Mandatory Course									
20MC302	Interpersonal skills	MC	0	0	2	0	100	-	100
TOTAL			**18**	**4**	**8**	**23**	**450**	**450**	**900**

IV SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
20MA401	Numerical Analysis and Statistics	BS	3	2	0	4	40	60	100
20ME401	Strength of Materials	ES	3	2	0	4	40	60	100
20ME402	Thermal Engineering	PC	3	0	0	3	40	60	100
20ME403	Manufacturing Technology – II	PC	3	0	0	3	40	60	100
Theory with Practical Course(s)									
20ME404	Engineering Metrology	PC	3	0	2	4	50	50	100
20EE409	Electrical Drives and Microprocessor	ES	3	0	2	4	50	50	100
Practical Course(s)									
20ME405	Thermal Engineering Laboratory	PC	0	0	2	1	50	50	100
20ME406	Manufacturing Technology Laboratory – II	PC	0	0	2	1	50	50	100
Mandatory Course									
20MC401	Soft Skills	MC	2	0	0	0	100	-	100
Total			**20**	**4**	**8**	**24**	**470**	**430**	**900**

V SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
20ME501	Design of Machine Elements	PC	3	2	0	4	40	60	100
20ME502	Heat and Mass Transfer	PC	3	0	0	3	40	60	100
20ME503	Computer Aided Manufacturing	PC	3	0	0	3	40	60	100
20MEEXX	Professional Elective – I	PE	3	0	0	3	40	60	100
20YYOXX	Open Elective – I	OE	3	0	0	3	40	60	100
Theory with Practical Course(s)									
20ME504	Dynamics of Machinery	PC	3	0	2	4	50	50	100
Practical Course(s)									
20ME505	Heat Transfer Laboratory	PC	0	0	2	1	50	50	100
20ME506	Computer Aided Manufacturing Laboratory	PC	0	0	2	1	50	50	100
TOTAL			**18**	**2**	**6**	**22**	**350**	**450**	**800**

VI SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
20ME601	Design of Transmission System	PC	3	2	0	4	40	60	100
20ME602	Finite Element Analysis	PC	3	2	0	4	40	60	100
20MEEXX	Professional Elective - II	PE	3	0	0	3	40	60	100
20YYOXX	Open Elective – II	OE	3	0	0	3	40	60	100
Theory with Practical Course(s)									
20ME603	Mechatronics Engineering	PC	3	0	2	4	50	50	100
Practical Course(s)									
20ME604	Modeling Laboratory	PC	0	0	4	2	50	50	100
20ME605	Mini Project	EEC	0	0	2	1	50	50	100
20ME606	Internship	EEC	Two Weeks			1	100	0	100
Total			**15**	**4**	**8**	**22**	**410**	**390**	**800**

VII SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
20ME701	Entrepreneurship and Professional Ethics	PC	3	0	0	3	40	60	100
20ME702	Total Quality Management	HSS	3	0	0	3	40	60	100
20MEEXX	Professional Elective - III	PE	3	0	0	3	40	60	100
20MEEXX	Professional Elective - IV	PE	3	0	0	3	40	60	100
20YYOXX	Open Elective – III	OE	3	0	0	3	40	60	100
Practical Course(s)									
20ME704	Simulation and Analysis Laboratory	PC	0	0	4	2	50	50	100
20ME705	Design Project	EEC	0	0	2	1	50	50	100
TOTAL			**15**	**0**	**6**	**18**	**300**	**400**	**700**

VIII SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20MEEXX	Professional Elective - V	PE	3	0	0	3	40	60	100
20MEEXX	Professional Elective – VI	PE	3	0	0	3	40	60	100
20ME801	Major Project	EEC	0	0	20	10	50	50	100
Total			**6**	**0**	**20**	**16**	**130**	**170**	**300**

PROFESSIONAL ELECTIVES (PE)									
Stream – I Design Engineering									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
20MEE01	Design Thinking	PE	3	0	0	3	40	60	100
20MEE02	Product Design	PE	3	0	0	3	40	60	100
20MEE03	Tool and Die Design	PE	3	0	0	3	40	60	100
20MEE04	Design of Hydraulic and Pneumatic Systems	PE	3	0	0	3	40	60	100
20MEE05	Design for Manufacturing and Assembly	PE	3	0	0	3	40	60	100
20MEE06	Optimization Techniques in Engineering Design	PE	3	0	0	3	40	60	100
20MEE07	Computational Fluid Dynamics	PE	3	0	0	3	40	60	100
20MEE08	Engineering Tribology	PE	3	0	0	3	40	60	100
20MEE09	Mechanical Vibrations	PE	3	0	0	3	40	60	100
20MEE10	Design of pressure vessels	PE	3	0	0	3	40	60	100
Stream – II Thermal Engineering									
20MEE21	Non-Conventional Energy Sources	PE	3	0	0	3	40	60	100
20MEE22	Power Plant Engineering	PE	3	0	0	3	40	60	100
20MEE23	Refrigeration and Air Conditioning	PE	3	0	0	3	40	60	100
20MEE24	Turbo Machines	PE	3	0	0	3	40	60	100
20MEE25	Gas Dynamics and Jet Propulsion	PE	3	0	0	3	40	60	100
20MEE26	Internal Combustion Engines	PE	3	0	0	3	40	60	100
20MEE27	Cryogenic Engineering	PE	3	0	0	3	40	60	100
20MEE28	Design of Heat exchangers	PE	3	0	0	3	40	60	100
20MEE29	Cogeneration and Waste Heat Recovery Systems	PE	3	0	0	3	40	60	100
20MEE30	Gas turbines	PE	3	0	0	3	40	60	100
Stream – III Manufacturing Engineering									
20MEE41	Additive Manufacturing	PE	3	0	0	3	40	60	100
20MEE42	Industrial Automation	PE	3	0	0	3	40	60	100

20MEE43	Modern Manufacturing Processes	PE	3	0	0	3	40	60	100
20MEE44	Industrial Robotics	PE	3	0	0	3	40	60	100
20MEE45	Advanced casting techniques	PE	3	0	0	3	40	60	100
20MEE46	Advanced welding techniques	PE	3	0	0	3	40	60	100
20MEE47	Process Planning and cost estimation	PE	3	0	0	3	40	60	100
20MEE48	Operations Research	PE	3	0	0	3	40	60	100
20MEE49	Manufacturing of composite materials	PE	3	0	0	3	40	60	100
20MEE50	CNC Machine tools	PE	3	0	0	3	40	60	100
20MEE51	Supply chain management	PE	3	0	0	3	40	60	100
Stream – IV Automobile Engineering									
20MEE61	Automobile Engineering	PE	3	0	0	3	40	60	100
20MEE62	Automotive transmission systems	PE	3	0	0	3	40	60	100
20MEE63	Vehicle body engineering	PE	3	0	0	3	40	60	100
20MEE64	Alternate fuels for automobiles	PE	3	0	0	3	40	60	100
20MEE65	Automotive emission and control	PE	3	0	0	3	40	60	100
20MEE66	Two and three wheelers	PE	3	0	0	3	40	60	100
20MEE67	Off road vehicles	PE	3	0	0	3	40	60	100
20MEE68	Electric and hybrid vehicles	PE	3	0	0	3	40	60	100
20MEE69	Vehicle maintenance	PE	3	0	0	3	40	60	100
20MEE70	Smart mobility	PE	3	0	0	3	40	60	100

OPEN ELECTIVE COURSES (For Other Branches)									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20MEO01	Integrated Product Development	OE	3	0	0	3	40	60	100
20MEO02	Manufacturing processes	OE	3	0	0	3	40	60	100
20MEO03	Automotive Technology	OE	3	0	0	3	40	60	100
20MEO04	Alternate energy sources	OE	3	0	0	3	40	60	100
20MEO05	Robotics	OE	3	0	0	3	40	60	100
20MEO06	Principles of management	OE	3	0	0	3	40	60	100

ONECREDIT COURSES									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20MEA01	Lean Manufacturing	EEC	1	0	0	1	100	0	100
20MEA02	Internet of things	EEC	1	0	0	1	100	0	100
20MEA03	Plastics – Processing, Tooling, Assembly and Testing	EEC	1	0	0	1	100	0	100
20MEA04	Automotive Electronics	EEC	1	0	0	1	100	0	100
20MEA05	CNC Programming	EEC	1	0	0	1	100	0	100
20MEA06	PLC Programming	EEC	1	0	0	1	100	0	100
20MEA07	Vehicle testing and certification	EEC	1	0	0	1	100	0	100

SUMMARY

S. No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDITS (AICTE)	CREDITS in %
		I	II	III	IV	V	VI	VII	VIII		
1.	HSS	3	3					3		9 (10-14)	5.45%
2.	BS	8	8	4	4					24 (22-28)	14.55%
3.	ES	6	9	4	8					26 (24)	15.76%
4.	PC	3		15	12	16	14	5		66 (48)	40.00%
5.	PE					3	3	6	6	18 (18)	10.91%
6.	OE					3	3	3		9	5.45%
7.	EEC						2	1	10	13 (12-16)	7.88%
8.	MC	0	0	0	0					0	0.00%
Total		20	20	23	24	22	22	18	16	165	100%

HSS - Humanities and Social Sciences
BS - Basic Sciences
ES - Engineering Sciences
PC - Professional Core
PE - Professional Electives
OE - Open Electives
EEC - Employability Enhancement Courses
MC - Mandatory Courses (Non-Credit Courses)
CA - Continuous Assessment
FE - Final Examination

I SEMESTER

20MA105	Mathematics - I for Mechanical Sciences (Common to AERO, MECH and SAFETY & FIRE ENGG)	L	T	P	C
		3	2	0	4
Nature of Course	Basic Sciences				
Pre requisites	Fundamentals of Basic Mathematics				

Course Objectives

The course is intended to

1. Acquire the concept of matrix algebra techniques.
2. Acquaint the mathematical tools needed in evaluating limits, derivatives and differentiation of one variable.
3. Learn the concept of calculus for solving the problems mathematically and obtaining solutions.
4. Study the functions of several variables, Taylor's series expansion and Jacobian techniques.
5. Introduce the concepts of evaluating multiple integrals.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Apply the concept of orthogonal reduction to diagonalise the given matrix.	Apply
CO2	Interpret the limit definition and rules of differentiation to differentiate the functions.	Understand
CO3	Identify the circle of curvature, evolutes and envelope of the curves.	Understand
CO4	Classify the maxima and minima for a given function with several variables through by stationary points.	Apply
CO5	Compute double and triple integrals.	Apply

Course Contents

Unit – I Matrices **12**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties(statement only) – Cayley-Hamilton theorem and its applications – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

Unit – II Limits and Continuity **12**

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules - Maxima and Minima of functions of one variable

Unit – III Differential Calculus **12**

Curvature – radius of curvature (Cartesian and polarco-ordinates) – Centre of curvature –Circle of curvature – Involute and evolute – envelope.

Unit – IV Functions of Several Variables **12**

Partial derivatives –Euler's theorem for homogenous functions –Differentiation of implicit functions Jacobians –Taylor's expansion –Maxima and Minima – Lagrange's Method of Undetermined Multipliers

Unit – V Multiple Integrals **12**

Double integration – Cartesian and polar coordinates – Change of order of integration –Area as double integral - Triple integration – Volume of solids by triple integration.

Total: 60 Periods

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Text Books:

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2016.
2. Veerarajan.T, "Engineering Mathematics for Semester I and II", Tata McGraw Hill, 3rd Edition, 2014.

Reference Books:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 1st edition, 2017.
2. Bali N.P, Manish Goyal, "A text book of Engineering Mathematics: Semester-I", Laxmi Publications (P) Ltd, 8th Edition, 2015.

Additional References:

1. https://nptel.ac.in/courses/111/105/111105121
2. https://nptel.ac.in/courses/122101003/2

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

Cos	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2											2	
CO2	3	3	2											2	
CO3	3	2	2											2	
CO4	2	3	2											1	
CO5	3	3	2											2	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination**
	IAE 1 (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20EC103	Basics of Electrical and Electronics Engineering	L	T	P	C
		3	0	0	3
Nature of Course	Engineering Sciences				
Pre requisites	Fundamentals of Electrical Engineering				

Course Objectives

1. The course is intended to understand the basic concepts of electrical elements and measuring instruments.
2. Gain knowledge of circuit laws.
3. Understand the various components used in electrical installations.
4. Illustrate the construction and operation of various electrical machines.
5. Explore the knowledge on semiconductor and digital circuits

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Explain the basic concepts of electrical elements and measuring instruments	Understand
CO2	Apply various circuit laws for solving complex circuits	Apply
CO3	Analyze the functions of various components used in electrical systems	Apply
CO4	Classify the static and dynamic machines and explain their operation.	Apply
CO5	Understand the basic functionalities of electronic circuits and devices	Apply

Course Contents:

Unit – I Electrical Elements and Measuring Instruments **9**

Resistance, Inductance, Capacitance, Wires and Cables Ammeter, Voltmeter, Wattmeter, Energy meter, Thermistor and Anemometer

Unit– II Electrical Circuits and Theorems **9**

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Theorems; Thevinin's, Norton's, Superposition, Maximum power transfer

Unit – III Electrical Installations Devices: **9**

Types of Protection devices: Fuses, MCB, ELCB, equipments for house wiring, simple house wiring and pump motor wiring.

Unit - IV Electrical Machines **9**

Construction and operating characteristics: DC Motor, Single Phase Transformer, Three phase Induction motor, Single phase induction motors, Synchronous Motor, and Stepper Motor.

Unit – V Semiconductor Devices and Digital Electronics **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion

Total: 45 Periods

Text Books

1. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics ", S. Chand & Co. Ltd., 2008.
2. Kothari D. P.,and I.J Nagarath I,J., "Electrical Machines – Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Third Reprint, 2016.
3. Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013.

Reference Books:

1. Nagsarkar T.K., and Sukhija M.S., "Basic of Electrical Engineering", Oxford University Press, 2011.
2. Laszlo Solymar, Donald Walsh, Richard R. A. Syms, "Electrical Properties of Materials", Oxford University press, 2014.
3. Toro V.D., "Electrical Engineering Fundamentals", Prentice Hall India, 2014.
4. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2										3	1	2
CO2	3	3	2										3	1	2
CO3	3	3	2										3	1	2
CO4	3	3	2										3	1	2
CO5	3	3	2										3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Understand	Quiz / Presentation/Tutorial	5	15
Understand	Assignment / Video presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE 1 (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse				
Evaluate				
Create				

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20ME102	Fundamentals of Mechanical Engineering	L	T	P	C
		3	0	0	3
Nature of Course	Engineering Sciences				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Impart knowledge of mechanical engineering fundamentals of application
2. Gain knowledge of mechanical process and their applications.
3. Learn the principles of power plant engineering with suitable properties.
4. Develop a clear understanding about internal combustion engines.
5. Explore the knowledge on thermodynamics for refrigeration cycles

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Summarize the metal casting process.	Understand
CO2	The joining process of metal to arc, electrode and gas welding process	Understand
CO3	Compare the properties of water tube and tube boilers	Understand
CO4	Infer and compare the performance of I.C engines	Understand
CO5	Contrast the refrigeration and air conditioning systems	Understand

Course Contents

Unit I Metal Casting Process 9

Manufacturing Process: Casting, pattern, pattern materials, types, allowances, molding tools, preparation of green sand mould, and manufacturing of cast iron, Cupola furnace, and operation, casting defects, causes and remedies.

Unit II Metal Joining Process 9

Arc welding, Arc welding equipment, electrode, welding process, defects in welding Gas welding, equipment

Unit III Power Plant Engineering 9

Thermal systems: Introduction, Classification of Power Plants, Working principle of steam, fire tube and water tube boilers

Unit IV Internal Combustion Engines 9

Internal combustion engines as automobile power plant, working principle of Petrol and Diesel Engines, Four stroke and two stroke cycles, Comparison of four stroke and two stroke engines

Unit V Refrigeration and Air Conditioning Systems 9

Terminology of Refrigeration and Air Conditioning, Principle of vapor compression refrigeration system, Layout of typical domestic refrigerator, Window and Split type room Air conditioner

Total: 45 Periods

Text Books

1. Shanmugam G , Palanichamy M.S., "Basic Civil and Mechanical Engineering", McGraw Hill Education, 2018.
2. Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promotors Pvt Ltd., Mumbai, 2010.
3 Rao P.N , "Manufacturing Technology", Tata McGraw-Hill Publishing Limited, II Edition, 2018

Reference Books

1. Magendran Parashar B.S. and Mittal R.K."Elements of Manufacturing Processes", Prentice Hall of India, 2003.
2. Gowri S., Hariharan P. and Suresh Babu A., "Manufacturing Technology 1", Pearson Education , 2008.
3. Sharma, P.C., "A text book of Production Technology", Chand, S and Company, IV Edition, 2003.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2										1		
CO2	3	3	2										1		
CO3	3	3	2										1		
CO4	3	3	2										1		
CO5	3	3	2										1		
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Understand	Direct Measures : Quiz / Presentation/ Tutorial	5	15
Understand	Indirect measures : Assignment/Video presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Exams			Final Examination (60)
	IAE 1 (7.5)	IAE 2 (7.5)	IAE 3 (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

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20CH103	Chemistry for Mechanical Sciences (Common to Aeronautical, Mechanical and Safety & Fire Engineering)	L	T	P	C
		3	0	2	4
Nature of Course	Basic Sciences				
Prerequisites	Nil				

Course Objectives

The course is intended to

1. Impart knowledge and understanding about the constituents present in water and the need for purification of water.
2. Understand the fundamentals of batteries.
3. Understand the nature and physical properties of lubricating oils.
4. Gain knowledge about fuels and calorific value of solid fuel, liquid fuel and gaseous fuel.
5. Understand the causes and control measures of corrosion.

Course Outcomes

On successful completion of the course, students will be able to

CO.No	Course Outcome	Bloom's Level
CO1	Develop innovative and eco-friendly method for water purification to meet the growing industrial demand	Apply
CO2	Understand the basic principles and mechanism of working of batteries and fuel cells	Understand
CO3	Interpret the importance of viscosity measurement of lubricating oils	Understand
CO4	Classify fuels based on their efficiency of combustion	Understand
CO5	Demonstrate the importance of protection of metals from corrosion	Apply

Course Contents

Unit-I Water Analysis and Water Treatment 9

Water analysis: Sources of water, Hard water and soft water, Hardness of water, acidity, alkalinity, pH value, amount of free CO_2, fluoride content and chloride content. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD). Water treatment: Definition, Zeolite process, Conditioning methods: Internal conditioning (Phosphate, Calgon) and external conditioning (Demineralization), Desalination, Reverse osmosis (RO).

Unit-II Energy Storage Devices 9

Batteries: Definition, characteristics and classification, Primary battery: Alkaline battery, Secondary battery: lead acid battery, nickel cadmium battery, lithium battery and lithium ion battery, Fuel cells: construction and working of phosphoric acid fuel cell.

Unit-III Lubricants 9

Meaning, mechanism of lubrication, liquid lubrication, properties, viscosity index, flash point and fire point, cloud point and pour point, oiliness, kinematic viscosity and common types of kinematic viscometer. Solid lubricants: graphite and molybdenum sulphide.

Unit-IV Fuels and Combustion 9

Solid fuel: Coal and its varieties, analysis of coal: proximate and ultimate with their significance, metallurgical coke: Definition Liquid fuel: petroleum oil. Knocking: octane number, improving octane number by additives Diesel: cetane number. Gaseous fuels - Water gas and Liquefied Petroleum Gas. Combustion: Introduction, Calorific value: Gross and net calorific value, Dulong's formula and problems.

Unit-V Corrosion and its Control 9

Corrosion: Classification, Types: Chemical corrosion and electrochemical corrosion, mechanism. Corrosion control: Corrosion inhibitors, cathodic protection (sacrificial anodic protection, impressed current cathodic protection), Protective coating, Paint constitutions and Electroplating (Au).

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Total: 45 Periods

Laboratory Component

S.No.	Name of the Experiment	CO Mapping	RBT
1	Determination of hardness of water	CO1	Apply
2	Determination of chloride content in water sample	CO1	Apply
3	Conductometric titration of strong acid versus strong base	CO2	Understand
4	Determination of strength of HCl by pH metry	CO2	Understand
5	Estimation of copper in brass by EDTA method	CO3	Apply
6	Determination of viscosity of a liquid using Ostwald Viscometer	CO3	Understand
7	Determination of water of crystallization of copper sulphate pentahydrate	CO4	Apply
8	Determination alkalinity of water sample and making a comparative study of corrosion rate	CO5	Understand

Total: 30 Periods

Text Books

1. O. G. Palanna, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 2nd Edition, 2017.
2. P. C. Jain and Monicka Jain, "Engineering Chemistry", Dhanapat Rai Publishing Company Pvt. Ltd, 11th Edition, 2017.

Reference Books

1. B. Sivasankar "Engineering Chemistry" Tata McGraw – Hill Pub.Co.Ltd, New Delhi, 2nd Edition, 2009.
2. R.Sivakumar and N. Sivakumar,"Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1st Edition, 2009.
3. Sivanesan and Nandagopal, "Engineering Chemistry-I", V.K.Pub. Pvt.Ltd, 2nd Edition 2011.

Additional Resources

1. https://nptel.ac.in/downloads/122101001
2. https://nptel.ac.in/courses/103103033/module9/lecture1.pdf
3. https://nptel.ac.in/courses/102103044/3
4. https://www.spectrosci.com/resource-center/lubrication-analysis/literature/e-guides/guide-to measuring-oil-viscosity
5. https://www.youtube.com/watch?v=Gs3gfwG9a7k
6. https://www.sciencedirect.com/topics/chemistry/phosphoric-acid-fuel-cells

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2													
CO2	3	2													
CO3	3	2													
CO4	3	2													
CO5	3	2													
	3	High				2	Medium					Low			

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Summative Assessment						
Bloom's Level	Continuous Assessment					Final Examination (Theory) [50]
	Theory				Practicals	
	IAE-I [7.5]	IAE-II [7.5]	IAE-III[10]	Attendance [5]	Rubric based CIA [20]	
Remember	30	20	10		20	40
Understand	10	20	30		20	40
Apply	10	10	10		10	20
Analyze						
Evaluate						
Create						

20ME101	Engineering Graphics (Common to Aeronautical, Agriculture, Civil, Mechanical, Safety and Fire Engineering & Food Technology)	L	T	P	C
		1	0	4	3
Nature of Course	Engineering Sciences				
Prerequisites	Nil				

Course Objectives:

The course is intended to

1. Understand technical drawings in various fields of engineering
2. Imagine and visualize the geometric details of engineering objects.
3. Translate the geometric information of engineering objects into engineering drawings.
4. Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings.
5. Visualize and draw isometric and perspective views

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Develop the conic sections, special curves, and draw orthographic views from pictorial views.	Apply
CO 2	Apply the principles of orthographic projections of points in all quadrants, lines and planes in first quadrant.	Apply
CO 3	Construct the projections of simple solids like prisms, pyramids, cylinder and cone.	Apply
CO 4	Build the sectional views of solids like cube, prisms, pyramids, cylinders & cones and development of its lateral surfaces.	Apply
CO 5	Organize and draw isometric and perspective sections of simple solids.	Apply

Course Contents

Concepts and Conventions (Not for Examination) **1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT -I Plane Curves and Free Hand Sketching **(3+12)**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT –II Projection of Points, Lines and Plane Surface **(3+12)**

Orthographic projection- principles-Principal Planes-First angle projection-projection of points Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT –III Projection of Solids **(3+12)**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT- IV Projection of Sectioned Solids and Development of Surface **(3+12)**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section, Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT -V Isometric and Perspective Projections **(3+12)**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL: (15+60) Periods

TEXT BOOKS

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011
2. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

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3. Parthasarathy N S and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.

Web References

1. http://nptel.ac.in/courses/112103019/Engineering drawing
2. http://pioneer.netserv.chula.ac.th/~kjirapon/self-practice.html

Publication of Bureau of Indian Standards

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable only to Final Examinations of Engineering Graphics:

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2										1	2		
CO2	3	2										1	2		
CO3	3	2										1	2		
CO4	3	3										1	2		
CO5	3	2										1	2		
	3	High				2	Medium				1	Low			

Summative assessment						
Bloom's Level	Continuous Assessment					Final Examination (Theory) [50 marks]
	Theory				Practical	
	IAE-I [7.5]	IAE-II [7.5]	IAE-III [10]	Attendance [5]	Rubric based CIA [20 Marks]	
Remember	10	10	10		20	20
Understand	20	20	20		40	40
Apply	20	20	20		40	40
Analyse						
Evaluate						
Create						

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20MC101	Induction Programme	L	T	P	C
		2	0	0	0
Nature of Course	Mandatory, Non Credit				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. To nurture the character and behaviour as a student.
2. To have broad understanding of society and relationships.
3. To impart interpersonal and soft skills.
4. To inspire the students in the field of engineering.
5. To provide exposure to industries.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Perform curricular and co-curricular activities excellently.	Knowledge
CO 2	Do the skill based training with excellence.	Understand
CO 3	Work as team for the given task	Apply
CO 4	Gain character and behaviour	Knowledge
CO 5	Demonstrate the acquired skills effectively	Apply

Course Contents

PHYSICAL ACTIVITY
Yoga, Sports
CREATIVE ARTS (students can select any one of their choice)
Painting, sculpture, pottery, music, craft making and so on
UNIVERSAL HUMAN VALUES
Enhancing soft skills
LITERARY AND PROFICIENCY MODULES
Reading, Writing, Speaking- Debate, Role play etc.,
Communication and computer skills
LECTURES BY EMINENT PEOPLE
Guest lecture by subject experts
VISIT TO LOCAL CITIES
Meditation centers / Industry
FAMILARIZATION TO DEPARTMENT / BRANCH INNOVATION
Lectures by Departments Head and senior faculty members

Total Hours: 45

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Mapping of COs with POs and PSOs

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1						2	1	2				3	2		
CO2						2	1	2				3	2		
CO3						2	1	2				3	2		
CO4						2	1	2				3	2		
CO5						2	1	2				3	2		
	3	High				2	Medium					1	Low		

Bloom's Level	**Continuous Assessment (Non-Credit, Mandatory)**				
	Test -I [20]	**Test -II [20]**	**Test - III [20]**	**Assignment/ Activity [20]**	**Attendance [20]**
Remember	10	10	10		
Understand	20	20	20	10	
Apply	20	20	20	10	
Analyse					
Evaluate					
Create					

20ENE01	**COMMUNICATIVE ENGLISH** (Common to all B.E. / B.Tech. Programmes)	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**
Nature of Course	Humanities and Social Science				
Pre requisites	Nil				

Course Objectives

The course is intended to

- Improve lexical, grammatical and semantic competence.
- Enhance communicative skills in real life situations.
- Augment thinking in all forms of communication.
- Equip with oral and written communication skills.
- Gain employability skills.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Use effectively the lexical, grammatical and semantic knowledge	Remember
CO2	Communicate with clarity using intentional vocabulary in English	Apply
CO3	Articulate perfectly and express their opinions confidently using communicative strategies	Remember
CO4	Accomplish listening and reading skills for lifelong learning	Understand
CO5	Comprehend, interpret and present data	Understand

Course Contents

Unit - I Basic structure and Usage 6

Parts of Speech — Articles –Tenses - Subject-Verb Agreement – Different Grammatical forms of the same word - Listening to Speeches and Conversations from Globareana software – Listening to Announcements – Listening and Gap Filling.

Unit - II Vocabulary and Language Development 6

Intentional vocabulary used in and around Airport, Hospital, Hotel, Court – Abbreviations and acronyms - One Word Substitution - Compound words – Homophones and Homonyms – Types of sentences - Ordering Jumbled Sentences Letter writing – informal.

Unit – III Oral Communication Skills 6

Improving fluency – Articulation with pronunciation – Voice modulation in Speaking – One minute talk -Self Introduction and introducing ones friend – Telephonic conversations – Group Discussion – Modal Auxiliaries – discourse markers.

Unit – IV Comprehensive Listening and Reading 6

Effective listening Strategies — Listening to Interviews from Globareana software – Phrasal verbs – Reading Comprehension – "An Astrologer's Day" by R.K.Narayan and "Building a New State" by Dr. A.P.J. Abdul Kalam.

Unit – V Effective Writing 6

Interpretation and presentation of data – developing Hints – general essays and paragraph writing – Report Writing – survey report and accident report - Instructions and Recommendations.

Total: 30 Periods

Laboratory Components

S.No	List of Exercises	CO Mapping	RBT
1	Role-play – One minute talk	3	Understand
2	Role-play – Telephonic conversations	3	Understand
3	Listening to speeches and lectures and gap filling	4	Understand
4	Group Discussion.	4	Understand
5	Articulation with pronunciation practice	3	Apply
6	Listening to Announcements – Listening and Gap Filling	4	Understand
7	Listening to Interviews & Native speakers' Conversations	4	Understand

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8	Reading practice with articles in magazine and news papers.	4	Understand
9	Model – Job Interviews	4	Understand
10	Introspective report – Personal analysis	5	Understand
11	Telephone etiquette	3	Remember
12	Reading – Shorter texts and News Articles	4	Understand
13	Role Play – Getting and Giving Permission	3	Remember
14	Self Introduction(Formal)	3	Understand
15	Recommendations/Suggestions	3	Apply

Total: 30 Periods

Text Books

1. Rizvi, Ashraf M., "Effective Technical Communication", Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2007.
2. Board of Editers, "Using English – A Coursebook for Undergraduate Engineers and Technologists", Orient BlackSwan Private Limited, Hyderabad, 2nd Edition, 2017.

Reference Books:

1. Meenakshi Raman and Sangeetha Sharma, "Technical Communication", Oxford University Press, USA, 10th Edition, 2007.
2. John Cunnison Catford, "A Practical Introduction to Phonetics", Clarendon Press, Jamaica, 2nd Edition, 2001.
3. Hewings. M, "Advanced English Grammar", Cambridge University Press, Chennai, 3rd Edition, 2000.
4. S P Dhanavel "English and Soft Skills", Orient BlackSwan Private Limited, Hyderabad, 1st Edition, 2010.

Web reference:

https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwij4dCTucfsAhXE1pYKHch4ABMYABABGgJ0bA&ohost=www.google.com&cid=CAASEuRo76H-Vx9BpazOOBfXeJSKVQ&sig=AOD64_3O-HNEnUO4A5sc31MsUfaTBGG-dQ&q&adurl&ved=2ahUKEwjC3ceTucfsAhXBeisKHatlBewQ0Qx6BAgfEAE

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							1			3	2	2	2		
CO2							1			3	2	2	2		
CO3							1			3	2	2	2		
CO4							1			3	2	2	2		
CO5							1			3	2	2	2		
	3	High				2	Medium				1	Low			

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Summative assessment						
Bloom's Level	Continuous Assessment					Final Examination (Theory) [50 marks]
	Theory Marks				Practical	
	IAE-I [7.5]	IAE-II [7.5]	IAE -III [10]	Attendance [5]	Rubric based CIA [20 Marks]	
Remember	20	20	20		40	40
Understand	20	20	20		40	40
Apply	10	10	10		20	20
Analyse						
Evaluate						
Create						

20ENE02	Advanced Communicative English (Common to all B.E / B.Tech. Programmes)	L	T	P	C
		2	0	2	3
Nature of Course	Humanities and Social Sciences				
Pre requisites	Basics of Communicative English				

Course Objectives

The course is intended to

1. Demonstrate satisfactory control over complex structures and mechanics in English.
2. Develop fluency and accuracy in oral communication
3. Communicate effectively and actively in social interactions.
4. Read English at inspectional level.
5. Face interviews with confidence.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Apply knowledge of English grammar for effective communication	Remember
CO2	Make use of common English phrases and vocabulary strength.	Understand
CO3	Build self-confidence and enhance professionalism	Apply
CO4	Implement listening, reading and writing skills in real - life situations	Apply
CO5	Speak fluently in English with proper pronunciation, intonation, tone and accent.	Understand

Course Contents

Unit – I Grammar and usage 6

Active voice and passive voice – Prefixes and suffixes – Connotation – Clauses - If conditionals – Idioms & Phrases - Right forms of verbs – Modal Auxiliaries - Spotting errors.

Unit - II Lexical competence 6

Technical Vocabulary - Expressions – Frequency – Cause and effect - Words often Miss-spelled – Syntax and structure - Homophones and Homonyms- Verbal analogy - Idioms and Phrases.

Unit - III Conversational etiquette 6

Processes description – Tone and accent in speech – Role-play (Job-Interview) – Presentation skills – Mechanics of presentation - Telephone etiquette – Group Discussion strategy - Formal & Informal subjective and objective introduction – Body Language – Mock Interview.

Unit – IV Listening reading and writing 6

Listen to Scientific / Technical talks and gap filling – Listening to TED/INK Talks – Reading – "Water: The Elixir of Life" by Sir. C.V.Raman. "Progress" by St. John Ervine - Instructions and Recommendations – Letter writing formal – Job application- Report writing – Introspective report – Creative writing – Essays and Paragraphs.

Unit – V Phonetics 6

Production and classification of speech sound – International Phonetic Alphabet and transcriptions – Phonological rules – way and Place of articulation – Vowels, consonants and diphthongs. Specific characteristics feature of vowel sounds.

Total: 30 Periods

Laboratory Components

S.No.	List of Exercises	CO Mapping	RBT
1	Role-play – Processes Description	CO2	Remember
2	Listening to TED/INK Talks and gap filling	CO4	Understand
3	Group Discussion	CO3	Understand
4	Articulation with pronunciation practice	CO3	Apply
5	Reading – Longer texts and Technical Articles (Skimming & Scanning).	CO4	Apply
6	Presentation skills – Mechanics of presentation	CO5	Understand
7	Individual presentation on given topics	CO5	Remember
8	Telephone etiquette	CO5	Understand
9	Instructions and Recommendations	CO5	Remember
10	Writing – General Essays.	CO4	Apply
11	Report writing technique- write up	CO4	Remember
12	Introspective report – Personal analysis	CO4	Understand
13	Model Job Interviews	CO3	Understand
14	Job Interviews(Role play)	CO3	Apply
15	Body Language	CO3	Understand

Total: 30 Periods

Text Books

1. Rizvi, Ashraf.M, "Effective Technical Communication", Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2007.
2. Hewings. M, "Advanced English Grammar", 3rd Edition, Cambridge University Press, Chennai, 5th Edition, 2000.
3. Board of Editers, "Using English – A Coursebook for Undergraduate Engineers and Technologists", Orient BlackSwan Private Limited, Hyderabad, 2nd Edition, 2017.

Reference Books:

1. Raman M & Sangeetha Sharma, "Technical Communication", Oxford University Press, USA, 10th Edition, 2007.
2. John Cunnison Catford, "A Practical Introduction to Phonetics",Clarendon Press, Jamaica, 2nd Edition, 2001.
3. Norman Whitby, Business Benchmark – "Pre-Intermediate to Intermediate, Students Book", Cambridge University Press, 1st Edition, 2006.
4. Dhanavel S. P., "English and Soft Skills", 1st Edition,Orient BlackSwan Private Limited, Hyderabad, 1st Edition, 2010.

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							1			3	2	2	2		
CO2							1			3	2	2	2		
CO3							1			3	2	2	2		
CO4							1			3	2	2	2		
CO5							1			3	2	2	2		
	3	High				2	Medium				1	Low			

Summative assessment						
Bloom's Level	Continuous Assessment					Final Examination (Theory)
	Theory Marks				Practical	
	IAE-I [7.5]	IAE-II [7.5]	IAE -III [10]	Attendance [5]	Rubric based CIA [20 Marks]	[50 marks]
Remember	20	20	20		40	40
Understand	20	20	20		40	40
Apply	10	10	10		20	20
Analyse						
Evaluate						
Create						

II SEMESTER

20MA205	Mathematics - II for Mechanical Sciences (Common to AERO, MECH and SAFETY & FIRE ENGG)	L	T	P	C
		3	2	0	4
Nature of Course	Basic Sciences				
Pre requisites	Fundamentals of Basic Mathematics				

Course Objectives

The course is intended to

1. Acquire the mathematical skills to solve the differential equations.
2. Acquaint the concepts of vector calculus needed in mechanical engineering field.
3. Study the rigorous and analytic approach to analyze the conformal mapping.
4. Learn the concept of complex integration to evaluate definite integrals.
5. Introduce Laplace transform techniques to solve ordinary differential equations.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Solve the linear and simultaneous differential equations.	Understand
CO2	Apply the basics of vector calculus comprising of gradient, line surface, volume integrals and the classical theorems.	Apply
CO3	Identify the concepts of analytic functions and its properties and apply it in conformal mapping.	Apply
CO4	Determine the singularities and its corresponding residues for the given function.	Apply
CO5	Compare Laplace transform, Inverse Laplace transform and solve the linear differential equations by Laplace transform techniques.	Apply

Course Contents

Unit - I Ordinary Differential Equations **12**

Differential equations with variable co-efficient: Cauchy's and Legendre's form of linear equation – Method of variation of parameters – Introduction of first order non- linear differential equation.

Unit – II Vector Calculus **12**

Gradient, Divergence and Curl –Directional derivative –Irrotational and solenoidal vector fields – Vector integration –Green's, Gauss divergence and Stokes' theorem –Statement, Verification and Simple applications

Unit – III Complex Differentiation and Conformal mapping **12**

Functions of a complex variable –Analytic functions –Statement of Cauchy –Riemann equations – Harmonic functions–Harmonic conjugate –Construction of analytic functions –Conformal mapping : w= z+c, cz, 1/z and Bilinear transformation.

Unit – IV Complex Integration **12**

Cauchy's Integral theorem (statement only) – Cauchy's integral formula – Taylor's and Laurent's series – Classification of singularities – Cauchy's residue theorem – Contour integration – Circular and semi-circular contours.

Unit – V Laplace Transforms **12**

Laplace transforms –Transform of elementary functions –Properties –Transform of periodic functions - Inverse Laplace transforms –Statement and applications of Convolution theorem –Initial and Final value theorems – Method of solving second order ODE with constant coefficients by using Laplace transforms technique.

Total: 60 Periods

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Text Books

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2016.
2. Bali N.P, Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications (P) LTD, 6th edition, 2015.

Reference Books

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 1st edition, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons (Asia) Limited, 10th Edition, 2018.

Additional References

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. htts://nptel.ac.in/courses/122/104/122104017

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2											2	
CO2	2	3	2											1	
CO3	3	2	1											3	
CO4	3	2	1											1	
CO5	2	3	2											2	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination**
	IAE 1 (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20ME201	Engineering Mechanics (Common to Aeronautical, Agriculture, Civil, Mechanical and Safety and Fire Engineering)	L	T	P	C
		3	2	0	4
Nature of Course	Engineering Sciences				
Pre requisites	Fundamentals of Basic Mathematics and Physics				

Course Objectives

The course is intended to

1. Develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
2. Make the students understand the vector and scalar representation of forces and Moments and the static equilibrium of particles and rigid bodies.
3. Understand the effect of friction on equilibrium, laws of motion, kinematics of motion and the interrelationship.
4. Make the students understand the properties of surfaces and solids, prediction of behavior of particles and rigid bodies under motion.
5. Make the students familiar with frictional laws and its application

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Illustrate the vectorial and scalar representation of forces and moments	Apply
CO 2	Find the rigid body in equilibrium.	Apply
CO 3	Determine the properties of surfaces and solids.	Apply
CO 4	Calculate dynamic forces exerted in rigid body	Apply
CO 5	Determine the friction and the effects by the laws of friction	Apply

Course Contents

UNIT - I Statics of Particles **12**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces –Principle of transmissibility .

UNIT - II Equilibrium of Rigid Bodies **12**

Free body diagram – Types of supports –Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT- III Properties of Surfaces and Solids **12**

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical

and spherical solids from first principle – Relation to area moments of inertia.

UNIT – IV Dynamics of Particles **12**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT - V Friction and Elements of Rigid Body Dynamics **12**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder and fly wheel

TOTAL: 60 Periods

Text Books

1. Rajasekaran, S. and Sankarasubramanian. G, "Fundamentals of Engineering 17 Mechanics", Vikas Publishing House Pvt. Ltd., New Delhi, 2009
2. Kumar, K.L., "Engineering Mechanics", Tata McGraw-Hill Publishing Company, New Delhi, 3rd Revised Edition, 2008

References

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", Tata McGraw-Hill Publishing Company, New Delhi, 8th Edition 2004
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", Pearson Education, 11th Edition, 2010

Web References

1. http://nptel.ac.in/courses/122104015/
2. http://nptel.ac.in/courses/112103109/

Online Resources

1. https://ocw.mit.edu/courses

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2		1									3		
CO2	3	2		1									3		
CO3	3	2		1									3		
CO4	3	2		1									3		
CO5	3	2		1									3		
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz or Tutorial Class	5	15
Understand	Assignment	5	
	Attendance	5	

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Bloom's Category	Summative Assessment			
	Internal Assessment Examinations			Final Examination
	IAE 1 (7.5)	IAE 2 (7.5)	IAE 3 (10)	(60)
Remember	10	10	10	20
Understand	10	10	10	20
Apply	20	20	20	40
Analyse				
Evaluate	10	10	10	20
Create				

20PH203	Physics for Mechanical Sciences (Common to Aeronautical, Mechanical & Fire and Safety Engineering)	L	T	P	C
		3	0	2	4
Nature of Course	Basic Sciences				
Pre requisites	Fundamentals of Basic Physics				

Course Objectives

The course is intended to

1. Impart knowledge of properties of matter like elasticity and its applications
2. Provide knowledge of optics, especially laser and their applications in fiber optics.
3. Learn the thermal properties of materials and their applications.
4. Understand the magnetic, piezo-electric and superconducting properties of materials.
5. Expose to new engineering materials like nano materials, shape memory alloys and metallic glasses.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Explain the knowledge about elastic modulus	Understand
CO2	Compare the working of lasers and propagation of light through optical fibers and its applications	Understand
CO3	Demonstrate the thermal conductivity of good and bad conductors	Understand
CO4	Outline the magnetic, piezoelectric and superconducting properties of the materials	Understand
CO5	Explain a conceptual understanding about the properties of new engineering materials like shape memory alloys, composites and metallic glasses	Understand

Course Contents

UNIT I Properties of Matter **9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever – uniform and non-uniform bending - I-shaped girders - stress due to bending in beams.

UNIT II Laser and Fiber Optics **9**

Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index, mode) – optical fiber communication system- fiber optic endoscope.

Unit III Thermal Physics 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications.

Unit IV Magnetic, Piezo Electric and Super Conducting Materials 9

Ferromagnetism- domain theory- types of energy- hard and soft magnetic materials – ferrites. Piezoelectric effect – piezoelectric crystal – Piezo-electric generator - principle and working – application of piezoelectric effect. Superconductivity – Meissner effect – Effect of magnetic field – Type I and Type II superconductors.

Unit V NewEngineering Materials 9

Metallic glasses – preparation, properties and applications – Shape memory alloys – Types, characteristics and applications – Nano materials – preparation – physical vapour deposition - sol gel method, properties and applications. Carbon Nano tube - properties and applications.

Total : 45 Periods

Laboratory Components

S.No	List of Experiments	CO Mapping	RBT
1	Determination of rigidity modulus – Torsion pendulum	CO1	Apply
2	Determination of Young's modulus by non-uniform bending method.	CO1	Apply
3	Determination of wavelength, and particle size using Laser	CO2	Apply
4	Determination of acceptance angle in an optical fiber	CO2	Apply
5	Determination of thermal conductivity of a bad conductor by Lee's Disc method	CO3	Apply
6	Determination of velocity of sound and compressibility of liquid by Ultrasonic interferometer	CO2	Apply
7	Determination of Coefficient of viscosity of liquid	CO1	Apply

Total:30 Periods

TEXT BOOKS

1. Bhattacharya D.K. and Poonam T., "Engineering Physics", Oxford University Press, 2nd Edition, 2015.
2. Avadhanulu M.N. and Kshirsagar P.G., "A Text book of Engineering Physics", S.Chand and company., New Delhi, 10th Edition, 2014.
3. William D Callister Jr. and David G Rethwisch., "Materials Science and Engineering", 9th Edition, John Wiley & Sons, Inc, 2019.

REFERENCES

1. David Halliday. Robert Resnick. and Jearl Walker., "Principles of Physics", Wiley, 10th Edition, 2014..
2. Raymond A Serway. and John W Jewett., "Physics for Scientists and Engineers", Cengage Learning, 9th Edition, 2019.
3. Raghavan V., "Materials Science and Engineering, A First course", PHI Learning, 5th Edition, 2015.

Web References:

1. https://nptel.ac.in/courses/115/101/115101012/
2.https://www.youtube.com/watch?v=9bhG0hkKjcA
3.https://theconstructor.org/concrete/expansion-joint-concrete/25161/
4.https://spaceplace.nasa.gov/laser/en/

Passed in Board of studies Meeting on 21.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1												
CO2	3	1	1												
CO3	3	1	1												
CO4	3	1	1												
CO5	3		1												
	3 | High					2 | Medium						1	Low		

Summative assessment						
Bloom's Level	Internal Assessment					Final Examination (Theory) [50 marks]
	Theory Marks				Practical	
	IAE-I [7.5]	IAE-II [7.5]	IAE-III [10]	Attendance [5]	Rubric based CIA [20 Marks]	
Remember	10	10	10			20
Understand	35	35	35		40	70
Apply	5	5	5		60	10
Analyse						
Evaluate						
Create						

20CS201	PROBLEM SOLVING USING PYTHON (Common to all Branches)	L	T	P	C
		3	0	2	4
Nature of Course	Engineering Sciences				
Pre requisites	Mathematical and Logical Knowledge				

Course Objectives

The course is intended to

1. Think logically and write algorithm and draw flow charts for problems
2. Read and write simple Python programs.
3. Develop Python programs with conditionals and loops.
4. Define Python functions and call them.
5. Use Python data structures — lists, tuples, dictionaries and files.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Develop algorithmic solutions to simple computational problems and read, write, execute by simple python programs.	Apply
CO2	Structure simple python programs for solving problems.	Understand
CO3	Administer the role of control statements and functions involving the idea of modularity.	Apply
CO4	Represent compound data using python strings and lists.	Apply
CO5	Read and write data from/to files in python Programs.	Understand

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Course Contents

UNIT I **Basics of Computers & Problem Solving** **9**

Computer Basics – Components-Computer organization - Computer Software- Types of software - Software Development steps -Need for logical analysis and thinking- Algorithms – Flowchart - Number system.

UNIT II **Introduction of Python Programming** **9**

Introduction-Python Interpreter-Interactive and script mode -Values and types, variables, operators, expressions, statements, precedence of operators, Multiple assignments, comments, Input and Output Statements.

UNIT III **Control statements and Functions** **9**

Conditional (if), alternative (if-else), chained conditional (if-elif-else)-Iteration-while, for, break, continue, pass – Functions - Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion, Lambda functions.

UNIT IV **Strings and Lists** **9**

Strings-String slices, immutability, string methods and operations -Lists-creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions-list processing-list comprehension, searching and sorting.

UNIT V **Tuples, Dictionaries and Files** **9**

Tuples- Tuple assignment, lists and tuples, Tuple as return value- Dictionaries-operations and methods, Files and Exception-Text files, reading and writing files, format Operator, Exception handling.

TOTAL : 45 Periods

Laboratory Components

S.No	List of Exercises	CO Mapping	RBT
1	Write a algorithm & draw flowchart for simple computational problems	CO1	Understand
2	Write a program to perform different arithmetic operations on numbers in python.	CO2	Understand
3	Write a python program to implement the various control Structures	CO3	Apply
4	Write a python program for computational problems using recursive function.	CO3	Apply
5	Demonstrate use of list for data validation.	CO4	Apply
6	Develop a python program to explore string functions	CO4	Analyze
7	Implement linear search and binary search.	CO4	Apply
8	Develop a python program to implement sorting methods	CO4	Analyze
9	Develop python programs to perform operations on dictionaries.	CO5	Analyze
10	Write a python program to read and write into a file	CO5	Apply

TOTAL: 30 Periods

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Text Books

1. Reema Thareja, "Problem Solving and Programming with Python", Oxford University Press, 2018.
2. Dr. R. Nageswara Rao, "Core Python Programming", Dream tech Press, 2017.

Reference Books

1. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012
2. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python" , Mc-Graw Hill Education, 2018.
3. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India Edition, 2013
4. Timothy A. Budd," Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3	1	
CO2	3	2	1										3	1	
CO3	3	2	2										3	1	
CO4	3	2	2										3	1	
CO5	3	2	2										3	1	
	3	High				2	Medium					1	Low		

Summative assessment						
Bloom's Level	Continuous Assessment					End Semester Examination (Theory) [50 marks]
	Theory Marks				Practical	
	IAE-I [7.5]	IAE-II [7.5]	IAE-III [10]	Attendance [5]	Rubric based CIA [20 Marks]	
Remember	10	10	10			20
Understand	20	20	20		30	50
Apply	20	20	20		50	30
Analyse					20	
Evaluate						
Create						

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20ME202	Mechanical Engineering Practices Laboratory	L	T	P	C
		0	0	2	1
Nature of Course	Engineering Sciences				
Pre requisites	Fundamentals of Science				

Course Objectives

The course is intended

1. To provide hands on training in foundry practice
2. To practice butt joints, lap joints and T- joints by Metal arc welding.
3. To fabricate models using sheet metal
4. To make joints using carpentry tools.
5. To build pipeline joints as per location and functional requirements.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Construct green sand mould in foundry	Apply
CO 2	Experiment with arc welding equipments to join the structures	Apply
CO 3	Make the models using sheet metal	Apply
CO 4	Fabricate joints in carpentry components	Apply
CO 5	Carry out basic machining operations and pipe connections including plumbing works	Apply

List of Exercises

S.No	Exercises	CO Mapping	RBT LEVEL
Foundry			
1	Preparation of green sand mould	CO 1	Apply
Welding			
2	Lap joint using Arc welding	CO 2	Apply
3	Butt joint using Arc welding	CO 2	Apply
4	Tee joint using Arc welding	CO 2	Apply
Sheet metal			
5	Fabrication of tray using sheet metal	CO 3	Apply
6	Fabrication of cone using sheet metal	CO 3	Apply
Carpentry			
7	Cross lap joint using wood	CO 4	Apply
8	Tee lap joint using wood	CO 4	Apply
9	Dove-tail joint using wood	CO 4	Apply
Special Machines			
10	Drilling of hole in the given work piece	CO 5	Apply
Plumbing			
11	External thread cutting	CO 5	Apply
12	Domestic water pipe line connection	CO 5	Apply

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			3									3	2		
CO2			3									2	2		
CO3			3									2	2		
CO4			3									2	2		
CO5			3									2	2		
	3	High				2	Medium				1	Low			

Summative Assessment based on Continuous and Final Examination		
Bloom's Level	Rubric based Continuous Assessment [50 marks]	Final Examination [50 marks]
Remember		
Understand	20	20
Apply	30	30
Analyze		
Evaluate		
Create		

20MC201	ENVIRONMENTAL SCIENCES (Common to Agriculture, Food Technology, Aero, Civil, Mechanical and Fire &Safety Engineering)	L	T	P	C
		2	0	0	0
Nature of Course	Mandatory				
Prerequisites	Nil				

Course Objectives

The course is intended to

1. Understand the concept of eco system and environment.
2. Become conversant with ecological balance and values of bio diversity.
3. Know the role of human in prevention of pollution and making a clean environment.
4. Get knowledge about conservation of non conventional energy resources.
5. Study about the nature and management of e-waste and solid waste.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Describe the ecosystem and environment	Understand
CO2	Understand the ecological balance and preservation of bio diversity	Understand
CO3	Demonstrate various types of pollution in order to control pollution	Apply
CO4	Classify the energy sources for the conservation of non conventional energy sources	Understand
CO5	Identify the nature and management of e-waste and solid waste	Apply

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Course Contents

Unit-I Ecosystem 6

Eco system - Food chains, Food webs and Ecological pyramids. Ecosystem - (a) Forest eco system, (b) Aquatic eco system (pond ecosystem and marine ecosystem).

Unit-II Biodiversity 6

Introduction to Bio diversity, Values of Bio diversity, Threads to Bio diversity, Endangered and Endemic species of India, Hotspots of biodiversity. Conservation of Bio diversity: In-Situ and Ex-Situ conservation of bio diversity.

Unit-III Environmental Pollution 6

Definition, Causes, Effects and Control of (a) Air pollution (b) Water pollution (c) Soil pollution Electrostatic Precipitator for controlling air pollution

Unit-IV Non Conventional Energy Resources 6

Introduction, Types: Solar Energy, Wind Energy and Geo Thermal Energy.

Unit-V Environmental Management 6

Sustainable Development, Role of Information technology in Environment and Human HIV and AIDS: causes and control measures. Green chemistry: Definition and Principles

Activity Component

S.No	Name of the Experiment	CO Mapping	RBT
1	Field study of simple eco system: pond, river and hill slopes	CO1	Understand
2	Case study regarding environmental management	CO5	Apply

Total: 30 periods

Text Books

1. Anubha Kaushik and C.P. Kaushik, "Environmental Science and Engineering, New Age International Publishers, New Delhi, 2nd Edition, 2015
2. V. Kumar, "An Introduction to Green Chemistry" Vishal publishing Co. Reprint Edition, 2010

Reference Books

1. Masters, Gilbert M, "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi, 2nd Edition, 2012
2. Santosh Kumar Garg and Rajeshwari Garg "Ecological and Environmental Studies", Khanna Publishers, Nai Sarak, Delhi, 2nd Edition, 2014

Additional Resources

1. https://nptel.ac.in/courses/122103039/38
2. https://bch.cbd.int/cms/ui/collaboration/download/download.aspx?id=909
3. https://nptel.ac.in/courses/105102089/air%20pollution%20(Civil)/Module-3/3a.htm
4. www.vssut.ac.in/lecture_notes/lecture1428910296.pdf
5. nptel.ac.in/courses/120108004/module7/lecture8.pdf

Passed in Board of studies Meeting on 24.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							3					3			
CO2							3					3			
CO3							3					3			
CO4							3					3			
CO5							3					3			
	3	High					2	Medium				1	Low		

Bloom's Level	Continuous Assessment				
	IAE-I [20]	IAE-II [20]	IAE-III [20]	Attendance [10]	Activity [30]
Remember	30	20	20		
Understand	10	20	20		
Apply	10	10	10		
Analyze					
Evaluate					
Create					

Passed in Board of studies Meeting on 21.10.2020

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20ENE02	Advanced Communicative English (Common to all B.E./ B.Tech. Programmes)	L	T	P	C
		2	0	2	3
Nature of Course	Humanities and Social Sciences				
Pre requisites	Basics of Communicative English				

Course Objectives

The course is intended to

1. Demonstrate satisfactory control over complex structures and mechanics in English.
2. Develop fluency and accuracy in oral communication.
3. Communicate effectively and actively in social interactions.
4. Read English at inspectional level.
5. Face interviews with confidence.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Apply knowledge of English grammar for effective communication	Remember
CO2	Make use of common English phrases and vocabulary strength	Understand
CO3	Build self-confidence and enhance professionalism	Apply
CO4	Implement listening, reading and writing skills in real - life situations	Apply
CO5	Speak fluently in English with proper pronunciation, intonation, tone and accent.	Understand

Course Contents

Unit – I Grammar and usage 6

Active voice and passive voice – Prefixes and suffixes – Connotation – Clauses - If conditionals – Idioms & Phrases - Right forms of verbs – Modal Auxiliaries - Spotting errors.

Unit - II Lexical competence 6

Technical Vocabulary - Expressions – Frequency – Cause and effect - Words often Miss-spelled – Syntax and structure - Homophones and Homonyms- Verbal analogy - Idioms and Phrases.

Unit - III Conversational etiquette 6

Processes description – Tone and accent in speech – Role-play (Job-Interview) – Presentation skills – Mechanics of presentation - Telephone etiquette – Group Discussion strategy - Formal & Informal subjective and objective introduction – Body Language – Mock Interview.

Unit – IV Listening reading and writing 6

Listen to Scientific / Technical talks and gap filling – Listening to TED/INK Talks – Reading – "Water: The Elixir of Life" by Sir. C.V.Raman. "Progress" by St. John Ervine - Instructions and Recommendations – Letter writing formal – Job application- Report writing – Introspective report – Creative writing – Essays and Paragraphs.

Unit – V Phonetics 6

Production and classification of speech sound – International Phonetic Alphabet and transcriptions – Phonological rules – way and Place of articulation – Vowels, consonants and diphthongs. Specific characteristics feature of vowel sounds.

Total: 30 Periods

Laboratory Components

S.No	List of Exercises	CO Mapping	RBT
1	Role-play – Processes Description	2	Remember
2	Listening to TED/INK Talks and gap filling	4	Understand

3	Group Discussion	3	Understand
4	Articulation with pronunciation practice	3	Apply
5	Reading – Longer texts and Technical Articles (Skimming & Scanning).	4	Apply
6	Presentation skills – Mechanics of presentation	5	Understand
7	Individual presentation on given topics	5	Remember
8	Telephone etiquette	5	Understand
9	Instructions and Recommendations	5	Remember
10	Writing – General Essays.	4	Apply
11	Report writing technique- write up	4	Remember
12	Introspective report – Personal analysis	4	Understand
13	Model Job Interviews	3	Understand
14	Job Interviews(Role play)	3	Apply
15	Body Language	3	Understand

Total: 30 Periods

Text Books

1. , "Using English – A Coursebook for Undergraduate Engineers and Technologists", Orient Rizvi, Ashraf.M, "Effective Technical Communication", Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2007.

2. Hewings. M, "Advanced English Grammar", 3rd Edition, Cambridge University Press, Chennai, 5th Edition, 2000.

3. Board of EditersBlackSwan Private Limited, Hyderabad, 2nd Edition, 2017.

Reference Books:

1. Raman M & Sangeetha Sharma, "Technical Communication", Oxford University Press, USA, 10th Edition, 2007.
2. John Cunnison Catford, "A Practical Introduction to Phonetics",Clarendon Press, Jamaica, 2nd Edition, 2001.
3. Norman Whitby, Business Benchmark – "Pre-Intermediate to Intermediate, Students Book", Cambridge University Press, 1st Edition, 2006.
4. Dhanavel S. P., "English and Soft Skills", 1st Edition,Orient BlackSwan Private Limited, Hyderabad, 1st Edition, 2010.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							1			3	2	2	2		
CO2							1			3	2	2	2		
CO3							1			3	2	2	2		
CO4							1			3	2	2	2		
CO5							1			3	2	2	2		
	3	High				2	Medium				1	Low			

Passed in Board of Studies Meeting on 31.10.2020 — Approved in Academic Council Meeting on 06.11.2020

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Bloom's Level	Summative assessment					
	Continuous Assessment					Final Examination (Theory) [50 marks]
	Theory Marks				Practical	
	IAE-I [7.5]	IAE-II [7.5]	IAE -III [10]	Attendance [5]	Rubric based CIA [20 Marks]	
Remember	20	20	20		40	40
Understand	20	20	20		40	40
Apply	10	10	10		20	20
Analyse						
Evaluate						
Create						

20ENE03	Hindi	L	T	P	C
		2	0	2	3
Nature of Course	Humanities and Social Sciences				
Pre requisites	Basic Perceptive of Language				

Course Objectives

The course is intended for learners.

1. To help students acquire the basics of Hindi
2. To teach them how to converse in Hindi on simple day-to-day situations
3. To help students acquire the ability to understand a simple technical text in Hindi

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO.1	Construct simple sentences and use vocabulary required for day-to-day conversation	Remember
CO.2	Distinguish and understand the basic sounds of Hindi language.	Remember
CO.3	Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.	Remember
CO.4	Distinguish the words used in daily life	Understand
CO.5	Express individual opinion and speak fluently in Hindi	Understand

Course Contents:

UNIT I : Introduction 6

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - owel Signs- Chandra Bindu &Visarg -Table of Alphabet -Vocabulary.

UNIT II :Reading 6

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises

UNIT III: Grammar 6

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences – Interrogative Sentences.

UNIT IV : Vocabulary 6

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions

UNIT V: Speaking 6

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 30 Periods

Reference:

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							1			3	2	2	2		
CO2							1			3	2	2	2		
CO3							1			3	2	2	2		
CO4							1			3	2	2	2		
CO5							1			3	2	2	2		
	3	High				2	Medium				1	Low			

Summative assessment						
Bloom's Level	Continuous Assessment					Final Examination (Theory)
	Theory Marks				Practical	
	IAE-I [7.5]	IAE-II [7.5]	IAE -III [10]	Attendance [5]	Rubric based CIA [20 Marks]	[50 marks]
Remember	20	20	20		40	40
Understand	20	20	20		40	40
Apply	10	10	10		20	20
Analyse						
Evaluate						
Create						

N. Nataraj

Passed in Board of studies Meeting on 21.10.2020

CHAIRMAN - BOARD OF STUDIES

Approved in Academic Council Meeting on 06.11.2020

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20ENE04	French	L	T	P	C
		2	0	2	3
Nature of Course	Humanities and Social Sciences				
Pre requisites	Basic Perceptive of Language				

Course Objectives

The course is intended for learners.

1. To prepare the students for DELF A1 Examination
2. To teach them to converse fluently in French in day-to-day scenarios

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	To help students acquire familiarity in the French alphabet &basic vocabulary	Remember
CO2	listen and identify individual sounds of French	Remember
CO3	Use basic sounds and words whiles peaking	Remember
CO4	Read and understand short passages on familiar topics	Understand
CO5	Understand and use basic grammar and appropriate vocabulary in completing language tasks	Understand

Course Contents:

UNIT I : Entrer En Contact 6

La langue francaise, alphabets, les numeros, les jours, les mois. Grammaire Les verbes s"appeler,etre, avoir, les articles definis, indefinis Communication - Saluer, s"informer sur quelquun, demander de se presenter Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l"annee, les professions

UNIT II :Partager Son Lieu De Vie 6

Lesfrancaisetleur habitat, des habitation s in solitesGrammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : RegulieretIrregulier) –AdjectifsIdelieuCommunication - Chercher un logement, d"ecrire son voisin, s"informer sur un logementLexique - L"habitat, les pieces, l"equipement, la descriptionphysiqu

UNIT III: Vivre Au Quotidien 6

Grammaire - Articles contractes, verbesvouloir, pouvoir, devoir, adjective interrogative, future proche Communication- Exprimersesgouts, parler de sesloisirs, justifier un choix, exprimeruneenvieLexique - le temps libre et les loisirs, les saisons, les activitesquotidiennes, le temps (lematin, le soir, la nuit)

UNIT IV: Comprendre Son EnvironnementOuvrir La Culture 6

Grammaire – Verbes - Finir, Sortir, les adjectifsdemonstratifs, le passe compose, l"imparfait Communication - Propose aÃƒ?Ã‚quelqu""un de faire quelque chose, raconteur une sortie au passeparlerunfilmLexique - Les sorties, la famille, art, les vetementsetlesaccessoires

UNIT V: Gouter A La Campagne 6

Grammaire La forme negative, les verbesacheter, manger, payer, articles partitifs, le pronomen de quantite Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, argent.

Total: 30 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							1			3	2	2	2		
CO2							1			3	2	2	2		
CO3							1			3	2	2	2		
CO4							1			3	2	2	2		
CO5							1			3	2	2	2		
	3	High				2	Medium				1	Low			

Summative assessment						
Bloom's Level	**Continuous Assessment**					**Final Examination (Theory)**
	Theory Marks				**Practical**	
	IAE-I [7.5]	**IAE-II [7.5]**	**IAE -III [10]**	**Attendance [5]**	**Rubric based CIA [20 Marks]**	**[50 marks]**
Remember	20	20	20		40	40
Understand	20	20	20		40	40
Apply	10	10	10		20	20
Analyse						
Evaluate						
Create						

20ENE05	**German**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**
Nature of Course	Humanities and Social Sciences				
Pre requisites	Basic Perceptive of Language				

Course Objectives

The course is intended for learners.

1. To help students appear for the A1 level Examination
2. To teach them how to converse fluently in German in day-to-day scenarios

Course Outcome

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Listen and identify individual sounds of German	Remember
CO2	Use basic sounds and words while speaking	Remember
CO3	Read and understand short passages on familiar topics	Remember
CO4	Use basic sentence structures while writing	Understand
CO5	Understand and use basic grammar and appropriate vocabulary in completing language tasks	Understand

Course Contents:

UNIT I Introduction **6**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary

UNIT II Pronunciation **6**

Nouns - articles - Speaking about one self - Listening to CD supplied withthe books, paying special attention to pronunciation

UNIT III Basic Syntax **6**

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV Vocabulary **6**

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V: Action Words **6**

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 30 Periods

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE,Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi,2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen,2007.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							1			3	2	2	2		
CO2							1			3	2	2	2		
CO3							1			3	2	2	2		
CO4							1			3	2	2	2		
CO5							1			3	2	2	2		
	3	High				2	Medium				1	Low			

Passed in Board of studies Meeting on 21.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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Summative assessment						
Bloom's Level	Continuous Assessment					Final Examination (Theory) [50 marks]
	Theory Marks				Practical	
	IAE-I [7.5]	IAE-II [7.5]	IAE -III [10]	Attendance [5]	Rubric based CIA [20 Marks]	
Remember	20	20	20		40	40
Understand	20	20	20		40	40
Apply	10	10	10		20	20
Analyse						
Evaluate						
Create						

Passed in Board of studies Meeting on 21.10.2020

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Approved in Academic Council Meeting on 06.11.2020

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III- SEMESTER

20MA301	TRANSFORMS AND BOUNDARY VALUE PROBLEMS (Common to Aero, Mech, S&F, Civil, FT and Agri)	L	T	P	C
		3	2	0	4
Nature of Course	Basic Sciences				
Pre requisites	Mathematics-I & II for Mechanical Sciences				

Course Objectives

The course is intended to

1. Familiarize linear and non-linear partial differential equations with different methods.
2. Acquire the knowledge of Fourier series.
3. Acquaint with the Fourier series techniques in solving one dimensional wave and heat equations**.**
4. Learn the concept of Fourier transforms and it"s inverse.
5. Introduce the concept of Z-transforms and difference equations.

Course Outcomes

On successful completion of the course the students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Classify the linear and non-linear partial differential equations.	Understand
CO2.	Determine the Fourier series expansion.	Apply
CO3.	Interpret the solution of boundary value problems.	Understand
CO4.	Apply transform techniques to solve engineering problems.	Apply
CO5.	Illustrate the Z-transforms and difference equations.	Understand

Course Contents:

UNIT I Partial Differential Equations **12**

Solution of standard types of first order non-linear partial differential equations: (i) f(p,q)=0, (ii) Clairaut"s type - Lagrange"s linear equation - Homogeneous linear partial differential equations of second and higher order with constant coefficients (R.H.S =Constant, e^{ax+by} , $cos(ax+by)$, $sin(ax+by)$).

UNITII Fourier Analysis **12**

Condition for Fourier expansion -Fourier series for periodic functions- Determination of Fourier coefficients - Expansion of periodic functions with Period (0, 2L) and period (0, 2π) -Root mean square value on Fourier coefficients - Parseval"s identity

UNIT III Boundary Value Problems **12**

Classification of Partial differential equations–Method of separation of variables – Solutions of one dimensional wave equation – Solutions of one dimensional heat equation

UNIT IV Fourier Transforms **12**

Statement of Fourier integral theorem – Fourier transforms pair: Fourier transforms and Inverse Fourier transforms – Fourier sine transforms -Fourier cosine transforms – Transforms of simple functions – Parseval"s identity.

UNIT V Z - Transforms and Difference Equations **12**

Z-transforms - Properties – Inverse Z-transform: partial fraction and Convolution theorem - Formation of difference equations –Solution of difference equations using Z – transform.

Total: 60 Periods

Passed in Board of Studies Meeting on 25.06.2021 ***Passed in Academic Council Meeting on 04.10.2021***

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Text Books:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., 3rd edition, 2016.
2. Grewal B.S, “Higher Engineering Mathematics”, Khanna Publishers, 43rd Edition, 2017.

Reference Books:

1. Bali N.P and Manish Goyal, “A Text book of Engineering Mathematics”, Lakshmi Publications Pvt Ltd, 9th Edition, 2016.
2. Ramana.B.V,”Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company Limited, 4th Edition, 2016.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Publications, 10th Edition,2015.

Additional References:

1. https://pvpsitrealm.blogspot.com/2016/09/higher-engineering-mathematics-by-bs.html
2. https://reference.wolfram.com/language/tutorial/DSolvePartialDifferentialEquations.html

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	1	1	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment

Bloom’s Category	Internal Assessment Examinations			Final Examination (60)
	IAE- I (7.5)	IAE - II (7.5)	IAE - III (10)	
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

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20ME301	Engineering Thermodynamics	L	T	P	C
		3	2	0	4
Nature of course	Engineering Sciences				
Pre requisites	Mathematics I & II for mechanical sciences, Physics for mechanical sciences				

Course Objectives

The course is intended to

1. Acquire knowledge on thermodynamic systems, properties, laws of thermodynamics, entropy.
2. Understand the limitations of different energy conversion processes
3. Learn to solve problems of thermodynamic systems using thermodynamic relations.
4. Introduce the first and second laws of Thermodynamics to various thermal systems.
5. Learn about steam power cycles and properties of gas mixtures

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Identify the thermodynamic properties and solve the problems related to closed and open systems.	Apply
CO 2	Apply the Second law of thermodynamics and entropy principle to various thermodynamic cycles.	Apply
CO 3	Compare the available and unavailable energy and interpret the various thermodynamic relations.	Understand
CO 4	Determine the performance steam power cycle by using P-V, T-S, H-S diagrams.	Evaluate
CO 5	Select the properties of gas mixtures through gas laws for various applications.	Apply

Course Contents

Unit – I Basic Concepts and First Law of Thermodynamics **12**

Basic concepts - concept of continuum, macroscopic approach. Thermodynamic systems - closed, open and isolated. Property, state, path and process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. First law of thermodynamics – application to closed and open systems, steady flow process with reference to various thermal equipment.

Unit – II Second Law of Thermodynamics **12**

Second law of thermodynamics – Kelvin-Planck and Clausius statements, Reversibility and Irreversibility. Carnot theorem, Carnot cycle, reversed Carnot cycle, Efficiency, Coefficient of Performance. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy.

Unit – III Availability and Thermodynamic Relations **12**

Available and unavailable energy, concept of availability, irreversibility, Maximum Work in a Reversible Process, Availability in Non - Flow and Flow Processes. Maxwell relations - Tds Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius Clapeyron equation.

Unit – IV Properties of Pure Substance and Rankine Cycle **12**

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart. Basic Rankine cycle –Rankine cycle with reheating and regeneration.

Unit – V Ideal and Real Gases, Gas Mixtures **12**

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases Reduced properties. Compressibility factor, Generalized Compressibility Chart and its use. Mole and Mass fraction, Dalton‟s and Amagat‟s Law. Properties of gas mixture – Molar mass, gasconstant, density, change in internal energy, enthalpy, entropy and Gibbs function.

Total : 60 Periods

Text Books

1. P. K. Nag, "Engineering Thermodynamics",Tata-McGraw Hill Pub, 6th Edition, 2018.
2. Yunus A. Cengel and Michael A. Boles, "Thermodynamics: An Engineering Approach", Tata-McGraw Hill Pub, 9th Edition,2019.

Reference Books

1. Rajput, "Engineering Thermodynamics", Laxmi Publications, 4th Edition 2010
2. Gordon J. Van Wylan& Richard E. Sonntagg, "Fundamentals of Thermodynamics" Wiley Eastern Ltd, 7th Edition, 2009.
3. Dr.R.Yadav, Fundamentals of Engineering Thermodynamics, Central publishing House, 7th Edition, 2004.

Additional / Web References

1. http://nptel.ac.in/courses/112104113/
2. http://nptel.ac.in/courses/112108148/
3. http://nptel.ac.in/courses/112105123/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2		1									1	3	
CO 2	2	3		1									1	3	
CO 3	3	2		1									1	3	
CO 4	3	2		1									1	3	
CO 5	2	3		1									1	3	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10		20
Understand	10	20	10	20
Apply	30	20	20	40
Analyze				
Evaluate			20	20
Create				

20ME302	**Engineering Materials and Metallurgy** (Common to Aero & Mech)	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Pre requisites	Physics for Mechanical sciences				

Course Objectives

The course is intended to

1. Impart knowledge on the phase diagram of Iron and Steel.
2. Provide knowledge on Heat treatments of Steels.
3. Impart knowledge on ferrous and non ferrous alloys.
4. Provide knowledge on non metallic materials
5. Select suitable testing methods to determine the Engineering properties of materials.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Relate the phase changes, structures, properties and applications of steel and cast iron	Understand
CO 2	Classify the process of heat treatment of steels	Understand
CO 3	Relate the behaviour of Ferrous and Non Ferrous Alloys.	Understand
CO 4	Demonstrate the process, structure and applications of Non metals and Composites.	Understand
CO 5	Identify the behaviour of materials under Various loading conditions.	Apply

Course Contents

Unit –I Alloys and Phase Diagrams **9**

Constitution of alloys – Phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Carbon equilibrium diagram. Classification of steel and cast Iron - White, Malleable, Grey, Spheroidal, microstructure, properties and applications.

Unit –II Heat Treatment of Steel **9**

Definition – Full annealing, stress relief, recrystallization and spheroidising – normalising, hardening and Tempering of steel. Hardenability-Jominy end quench test - Austempering, martempering – case hardening, carburizing, nitriding and cyaniding – Flame and Induction hardening.

Unit –III Ferrous and Nonferrous Alloys **9**

Effect of alloying additions on steel - Stainless and tool steels – HSLA, Maraging steels –-– alloy cast irons, Copper alloys – Al-Cu alloys – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

Unit –IV Non Metallic Materials **9**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymer–PE, PP,PVC, ABS, PMMA, PS, Urea and Phenol formaldehydes- Engineering Ceramics - Al_2O_3, SiC, Si_3N_4 and SIALON –Introduction to smart and composite materials.

Unit –V Mechanical Properties and Testing **9**

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Brinnel and Vickers Hardness tests, Impact test - Izod and Charpy, fatigue and creep tests.

Total : 45 Periods

Text Books

1. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 9th Indian Reprint 2009.
2. Williams D Callister, “Material Science and Engineering” 2nd edition Wiley India Pvt Ltd, Revised Indian Edition 2014.

Reference Books

1. Dieter, G.E. ”Mechanical Metallurgy”,3rd Edition McGraw-Hill, 2017.
2. Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 6th Edition 2015.
3. Upadhyay. G.S. and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt. Ltd., New Delhi, 9th Edition, 2013.

Additional / Web References

1. https://nptel.ac.in/courses/112/108/112108150/#
2. http://www.issp.ac.ru/ebooks/books/open/Materials_Science_and_Technology.pdf
3. https://drive.google.com/file/d/1rtZisK2pKpi8JCFzg4Pboo7Kf5fKyjwa/view

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	2	3	2										2	2	
CO 2	2	3	2										2	2	
CO 3	2	3	2										2	2	
CO 4	2	3	2										2	2	
CO 5	2	3	2										2	2	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	40	40	20	60
Apply			20	20
Analyze				
Evaluate				
Create				

Passed in Board of Studies Meeting on 25.06.2021 ***Passed in Academic Council Meeting on 27.08.2021***

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20ME303	Fluid Mechanics and Machinery	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Pre requisites	Engineering mechanics				

Course Objectives

The course is intended to

1. Know the properties of fluids and concept of control volume.
2. Learn the conservation laws of flow through pipes.
3. Understand the importance of dimensional analysis
4. Understand the importance of various types of flow in pumps.
5. Understand the importance of various types of flow in turbines.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Identify the fluid properties and measure the flow characteristics	Apply
CO 2	Evaluate the loss of energy in flow through pipes	Evaluate
CO 3	Model the relationships for the flow parameters of fluids.	Apply
CO 4	Examine the performance of pumps for a given application	Analyse
CO 5	Select suitable turbine for given application and evaluate the operating characteristics	Apply

Course Contents

Unit –I Fluid Properties and Flow Characteristics **9**

Units and dimensions- Properties of fluids, Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

Unit –II Flow Through Circular Conduits **9**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuliBoundary layer concepts – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

Unit –III Dimensional Analysis **9**

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

Unit –IV Pumps **9**

Impact of jets - Euler"s equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - pumps– working principle - work done- performance curves.

Unit –V Turbines **9**

Classification of turbines – heads and efficiencies – velocity triangles. working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

Total : 45 Periods

Text Books

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 22nd edition, 2019.
2. Kumar K. L., "Engineering Fluid Mechanics", Tata-McGraw Hill , 4th Edition, 2017.

Reference Books

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, “Fluid Mechanics and Machinery”, 2011.
3. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co.,9th edition 2017

Additional / Web References

1. http://www.efluids.com/
2. https://www.quora.com/What-is-fluid-machines
3. https://nptel.ac.in/courses/112104117/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	3										1	2	
CO 2	3	2	3										1	2	
CO 3	3	2	3										1	2	
CO 4	3	3	2										1	2	
CO 5	3	2	3										1	2	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Understand	Online Quiz	5	15
Apply	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember				
Understand	20	20	20	40
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20ME304	Kinematics of Machinery	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Pre requisites	Engineering Mechanics				

Course Objectives

The course is intended to

1. Understand the basic components and layout of linkages in the assembly of a system/ machine
2. Understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
3. Understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
4. Understand the basic concepts of toothed gearing and kinematics of gear trains.
5. Understand the role of friction in drives and brakes.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Analyze the concepts of mechanisms, machines and their motions	Analyze
CO 2	Evaluate the displacement, velocity and acceleration of simple mechanism	Evaluate
CO 3	Construct different cam profiles for given conditions using graphical & theoretical methods.	Apply
CO 4	Estimate basic terminologies of gears and gear trains	Evaluate
CO 5	Choose friction drives in various mechanical components under different situations	Apply

Course Contents

Unit –I Basics of Mechanisms **9**

Introduction- resistant bodies- mechanism- structure – Grashof‟s law - Kutzbach criterion simple mechanism. Inversion of mechanisms. Synthesis of planar linkages.

Unit –II Kinematics of Linkage Mechanisms **9**

Displacement, velocity and acceleration, Coriolis acceleration analysis of simple mechanisms - Velocities and accelerations using analytical & graphical method.

Unit–III Kinematics of Cam Mechanisms **9**

Introduction of cams and followers – Displacement, velocity and acceleration diagrams using graphical & analytical methods– specified contour cams – circular arc and tangent cams-sizing of cams.

Unit–IV Gears and Gear Trains **9**

Introduction to gear– Spur, Helical, Bevel, Worm, Rack and Pinion gears terminology and definitions, Involutes and cycloidal tooth profiles Gear tooth actions – Gear trains, Epicyclic gear trains, Differentials, Automobile gearbox

Unit –V Friction in Machine Elements **9**

Friction drives - Friction in screw threads - Bearings and lubrication - Friction clutches - Belt and rope drives – Friction aspects in brakes – Friction in vehicle propulsion and braking.

Total : 45 Periods

Text Books

1. Rattan, S.S, "Theory of Machines", Tata McGraw-Hill, 5th Edition,2019.
2. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 3rdEdition, 2009.

Reference Books

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition, 2005.
2. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2017.
3. Khurmi, R.S. "Theory of Machines", S Chand Publications, 14th Edition, 2015.

Additional / Web References

1. nptel.ac.in/courses/Webcourse-contents/.../Kinematics%20of%20Machine/index.html
2. http://kmoddl.library.cornell.edu/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	2	3	2		2								1	2	
CO 2	2	3	2		2								1	2	
CO 3	2	3	2		2								1	2	
CO 4	2	3	2		2								1	2	
CO 5	2	3	2		2								1	2	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10		10	10
Understand		10		10
Apply		20	20	30
Analyze	20			20
Evaluate	20	20	20	30
Create				

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

20ME305	Manufacturing Technology - I	L	T	P	C
		3	0	2	4
Nature of course	Professional Core				
Pre requisites	Fundamentals of Mechanical Engineering				

Course Objectives

The course is intended to

1. Learn various aspects of different manufacturing techniques such as various casting methods and Techniques.
2. Have a broad knowledge on welding methods for making various joints.
3. Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.
4. Acquire knowledge about the various tools, equipment, machinery and operations required for these metal forming processes.
5. Introduce the basic concepts of plastic components manufacturing processes.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Explain different metal casting processes, associated defects, merits and demerits.	Understand
CO 2	Compare different metal joining processes	Understand
CO 3	Summarize various hot working and cold working methods of metals.	Apply
CO 4	Explain various sheet metal making processes.	Understand
CO 5	Distinguish various methods of manufacturing plastic components.	Understand

Course Contents

Unit – I Special Casting Processes **9**

Principles of special casting processes; shell moulding, investment casting, pressure die casting, centrifugal casting, CO_2 process, stir casting, induction furnace, testing of castings.

Unit – II Special Welding Processes **9**

Gas tungsten arc welding, gas metal arc welding, submerged arc welding, resistance welding, plasma arc welding, thermit welding, friction stir welding, brazing and soldering, welding defects, causes and remedies, automation of welding processes.

Unit – III Metal Forming Process **9**

Forging: Classification of forging processes – forging defects and inspection. Rolling-Hot and cold rolling, process parameters, drawing and extrusion.

Unit – IV Sheet Metal Processes **9**

Sheet metal forming methods - Shearing, Blanking, Bending, Stretch Forming, deep forming. Spinning. High Velocity Forming, Explosive forming, Electro hydraulic forming - magnetic pulse forming, pneumatic and mechanical high velocity forming.

Unit – V Manufacture of Plastic Components **9**

Plastic moulding processes– introduction to blow moulding, Rotational moulding, Film blowing, injection moulding, extrusion, Thermoforming, bonding of thermoplastics- Typical industrial applications

Total : 45 Periods

Laboratory Component

S.No.	Name of the Experiment	CO Mapping	RBT
1	Preparation of greensand mould for solid pattern	CO1	Apply
2	Preparation of greensand mould for split pattern	CO1	Apply
3	Joining of T shaped plates using Metal Arc Welding	CO2	Apply
4	Joining of plates using butt Welding	CO2	Apply
5	Cold forming of round into square	CO3	Apply
6	Cold forming of round into hexagon	CO3	Apply
7	Preparation of tray using sheet metal	CO4	Apply
8	Preparation of funnel using sheet metal	CO4	Apply
9	Preparation of joint in plastics	CO5	Apply
10	Preparation of T-Joint in plastics	CO5	Apply

Total: 30 Periods

Text Books

1. P.C. Sharma, “A Text Book of Production Technology (Manufacturing Processes)”, S. Chand & Company Ltd., New Delhi, 7th Reprint, 2012.
2. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India, 7th Edition, 2014.

Reference Books

1. Mikell P. Groover ”Fundamental of Modern Manufacturing”, Wiley India Edition, Third Edition, Reprint, 2012.
2. P.L.Jain, “Principles of Foundry Technology”, Tata McGraw Hill, 5th edition, 2017.
3. P.N.Rao, “Manufacturing Technology”, Tata McGraw Hill, New Delhi, Volume-1, 5th edition, 2018.

Additional / Web References

1. https://nptel.ac.in/courses/112107144/13
2. https://nptel.ac.in/courses/112107145/17
3. https://nptel.ac.in/courses/112107083/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	3	2										1	2	
CO 2	3	3	2										1	2	
CO 3	3	3	2										1	2	
CO 4	3	3	2										1	2	
CO 5	3	3	2										1	2	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Summative Assessment						
Bloom's Level	**Continuous Assessment**					**Final Examination (Theory) (50)**
	Theory				**Practical**	
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**Attendance (5)**	**Rubric based CIA (20)**	
Remember	20	10	20		20	20
Understand	30	20	30		20	40
Apply		20			60	40
Analyze						
Evaluate						
Create						

20ME306	Computer Aided Machine Drawing Laboratory	L	T	P	C
		0	0	2	1
Nature of course	PC				
Pre requisites	Engineering Graphics				

Course Objectives

The course is intended to

1. Familiarize the Indian Standards on drawing practices and impart knowledge of thread forms, fasteners, keys, joints and couplings.
2. Understand drawing the machine components leading to preparation of Geometric Dimensioning and Tolerance (GD&T) Assembly drawings manually and using CAD.
3. Outline the basic principles associated with CAD and to demonstrate common drafting techniques and shortcuts used by professionals.
4. Introduce the advanced capabilities of CAD and how they can be used to increase productivity.
5. Provide information about the CAD industry resources.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Interpret the drawings of machine components as to prepare assembly drawings using manual and Computer Aided Drafting (CAD).	Apply
CO2	Sketch part drawings, sectional views and assembly drawings as per standards using manual and Computer Aided Drafting (CAD).	Apply
CO3	Model the 3-D geometric information of machine components including assemblies and automatically generate Orthographic projection production drawings using manual and Computer Aided Drafting (CAD).	Apply
CO4	Understand the basic graphical (free hand sketch) fundamentals that are used to create and manipulate geometric models using manual and Computer Aided Drafting (CAD).	Apply
CO5	Improve visualization ability of machine components and assemblies before their actual fabrication through modeling, animation, shading, rendering, lighting and coloring using manual and Computer Aided Drafting (CAD).	Apply

Contents to be covered for manual drawing

Introduction to GD&T- Size (S)- Form (F)- Datums Control-Location (L)-Location (L)-Orientation (O)-Material Modifiers- Profile Tolerances- Run out Tolerances- Outcast Symbols to Avoid Concentricity, Symmetry

Contents to be covered for Computer Aided Drafting

To understand the fundamentals of CAD tools used in CAD software

Exercises (Manual and CAD)			
1.	Assembly of Flange Couplings	CO1	Apply
2.	Assembly and Sleeve and Cotter Joint	CO2	Apply
3.	Assembly of Connecting rod	CO3	Apply
4.	Assembly of Plummer Block	CO4	Apply
5.	Assembly of Screw Jack	CO5	Apply
			Total : 30 Periods

Text Books

1. Gopalakrishna K.R., "Machine Drawing", Subhas Stores Books Corner, Bangalore, 22nd Edition, 2013.
2. N. D. Bhatt and V.M. Panchal, "Machine Drawing", Charotar Publishers, 50th Edition, 2014.

Reference Books

1. Junnarkar, N.D., "Machine Drawing", Pearson Education, 1st Edition, 2004.
2. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing" , published by Tata McGrawHill, 2006.
3. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2008.

Additional / Web References

1. http://www.nptel.ac.in/
2. http://www.sigmetrix.com/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	2	3	2						1	1		1	1	3	
CO 2	2	3	2						1	1		1	1	3	
CO 3	2	3	2						1	1		1	1	3	
CO 4	2	3	2						1	1		1	1	3	
CO 5	2	3	2						1	1		1	1	3	
	3	High				2	Medium					1	Low		

Assessment based on Continuous and Final Examination			
Bloom's Level	**Continuous Assessment (50 marks) (Attendance – 5 marks)**		**Final Examination [50 marks]**
	Rubric based Continuous Assessment [25 marks]	**Model Examination [20 marks]**	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyze			
Evaluate			
Create			

20ME307	Fluid Mechanics and Strength of Materials Laboratory	L	T	P	C
		0	0	2	1
Nature of course	Professional core				
Pre requisites	Fluid mechanics and machinery, Engineering materials and metallurgy				

Course Objectives

The course is intended to

1. Learn the principles studied in Fluid Mechanics theory by performing experiments in lab.
2. Study the mechanical properties of materials when subjected to different types of loading.
3. Know the principles studied in Fluid Mechanics theory by performing experiments in lab.
4. Experiment the fundamental principles of mechanics of materials (strength of materials)
5. Measure mechanical properties of deformable bodies.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Select the measurement equipments for flow measurement.	Apply
CO 2	Examine the performance of different fluid machineries.	Analysis
CO3	Experiment with Tensile and double shear tests	Apply
CO4	Utilize torsion and Impact tests.	Apply
CO5	Make use of Hardness and Deflection tests.	Apply

S.No.	Fluid Mechanics - List of Experiments	CO Mapping	Revised Bloom's Taxonomy
1	Determination of the Coefficient of discharge of given Orifice meter and Venturi meter.	CO 1	Apply
2	Calculation of the rate of flow using Rota meter	CO 1	Apply
3	Determination of friction factor for a given set of pipes.	CO 1	Apply
4	Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump	CO 2	Analysis
5	Conducting experiments and drawing the characteristic curves of reciprocating pump	CO 2	Analysis
6	Conducting experiments and drawing the characteristic curves of Pelton wheel.	CO 2	Apply
			Total : 30 Periods

S.No.	Strength of Materials - List of Experiments	CO Mapping	Revised Bloom's Taxonomy
1.	Tension test on a mild steel rod	CO3	Apply
2.	Double shear test on Mild steel and Aluminium rods	CO3	Apply
3.	Torsion test on mild steel rod	CO4	Analysis
4.	Impact test on metal specimen	CO4	Analysis
5.	Hardness test on metals - Brinnell and Rockwell Hardness Number	CO5	Analysis
6.	Deflection test on beams	CO5	Apply
			Total : 30 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	1	2		3								1	1	2	
CO 2	1	2		3								1	1	2	
CO 3	1	2		3								1	1	2	
CO 4	1	2		3								1	1	2	
CO 5	1	2		3								1	1	2	
	3	High				2	Medium					1	Low		

Assessment based on Continuous and Final Examination

Bloom's Level	Continuous Assessment (50 marks) (Attendance – 5 marks)		Final Examination [50 marks]
	Rubric based Continuous Assessment [25 marks]	Model Examination [20 marks]	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyze			
Evaluate			
Create			

CHAIRMAN - BOARD OF STUDIES

Passed in Board of Studies Meeting on 25.06.2021 ***Passed in Academic Council Meeting on 27.08.2021***

CHAIRMAN - ACADEMIC COUNCIL

20MC302	Interpersonal Skills	L	T	P	C
		0	0	2	0
Nature of Course	Mandatory, Non Credit				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Use interpersonal communication skills to influence and build good relationships.
2. Identify and pursue personal learning goals.
3. Obtain feedback skills in service of evolving learning goals.
4. Learn about group dynamics, behaviors and feelings
5. Enhance the communication process in both formal and informal contexts

Course Outcomes

On successful completion of the course, students will be able to

CO.No	Course Outcome	Bloom's Level
CO1	Practice interpersonal communication skills to influence and build good relationships	Understand
CO2	Identify and pursue personal learning goals.	Understand
CO3	Give evident feedback	Understand
CO4	Reveal group dynamics and amiable behavior	Understand
CO5	Emphasis the communication process	Understand

Course Contents:

Unit – I Fundamentals of Interpersonal Communication 6

Facts of communication and Interpersonal communication – culture and gender – Communication and Self disclosure – Presentation ofInterpersonal perception - Learning goals – Feeling and feedback

Unit – II Interpersonal communication in action 6

Nature of language – language and culture – usage and abuse of language –Positive communication -Non verbal communication - Listening strategies – Barriers of listening.

Unit– III Emotional Intelligence 6

Influence of emotional experience and expressions – Accepting the responsibilities and changes - Negotiation tactics - Dealing with criticism and appreciation - Collaborative Problem Solving - Resilience Building.

Unit – IV Transactions 6

Different types of transactions - Building Positive Relationship - Managing Conflict – Connecting across Difference –Factors hampering Interpersonal interactions – Assertiveness in communication

Unit – V Essential Interpersonal Competencies 6

Behaviour – Understanding limiting behaviour - Interpersonal and small group behavior – Critical and lateral thinking-Win –Win attitude – Positive thinking – Stress management – Assertive feedback - Personal Evaluation of Interpersonal Relationship Skills

Total 30 Periods

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Activity Component

S.No	Name of the Exercises	CO Mapping	RBT
1	Self Introduction	CO1	Understand
2	Presentation of Individual perception	CO2	Understand
3	Role play - Non verbal communication - Body language	CO 4	Understand
4	Role play - Interpersonal interactions &Assertive feedback	CO 3	Understand
5	Group Discussion	CO 4	Understand
6	Role play - Situational conversation (On spot)	CO5	Understand

Text Books

1. Bozeman, Jeanine C and Argile Smith, “Interpersonal Relationship Skills for Ministers”Gretna, LA: Pelican Publishing Company, 1st Edition, 2004.

2. Floyd, Kory, “Interpersonal Communication”, 4th edition McGraw-Hill, 2nd Edition, 2020.

Reference Books:

1. Augsburger, David, “Caring Enough to Confront How to Understand and Express Your Deepest Feelings Towards Others”, updated ed. Ventura, CA: Regal Books, 2nd Edition, 2009.

2. Vohs, Kathleen D., and Eli J., Finkel, eds, “Self and Relationships: Connecting Intrapersonal and Interpersonal Processes”, New York: Guilford Press, 1st Edition, 2006.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3										1	3	
CO2	3	3	3										1	3	
CO3	3	3	3										1	3	
CO4	3	3	3										1	3	
CO5	3	3	3										1	3	
	3	High				2	Medium				1	Low			

Bloom’s Level	Summative Assessment (Internal Mode)	
	Assessment 1	**Assessment 2**
Remember	20	20
Understand	10	10
Apply	20	20
Analyze		
Evaluate		
Create		

IV SEMESTER

20MA401	NUMERICAL ANALYSIS AND STATISTICS (Common to Aero, Mech, S&F, Civil and Agri)	L	T	P	C
		3	2	0	4
Nature of Course	Basic Sciences				
Pre requisites	Mathematics –I & II for Mechanical Sciences				

Course Objectives

The course is intended to

1. Introduce the basic concepts of algebraic and transcendental equations.
2. Acquire the concept of numerical techniques of differentiation and integration.
3. Study the numerical techniques in solving ordinary differential equations.
4. Acquaint with the knowledge of testing of hypothesis for small and large samples.
5. Familiarize with the basic concept on types of design of experiments used in the field of engineering.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Illustrate the algebraic and transcendental equations.	Understand
CO2	Apply the numerical techniques of interpolation and error approximations in various intervals in real life situations.	Apply
CO3	Classify the numerical techniques for solving first and second order ordinary differential equations.	Understand
CO4	Interpret the testing of hypothesis for small and large samples.	Apply
CO5	Explain the basic concepts of classifications of design of experiments in the field of engineering	Understand

Course Contents:

UNIT - I Solution of Equations and Eigen value problems **12**

Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method - Iterative methods of Gauss Jacobi method and Gauss Seidel method– Eigen values of a matrix by Power method.

UNIT - II Numerical differentiation and integration **12**

Lagrange‟s interpolations- Newton‟s divided difference interpolations – Newton‟s forward difference and backward difference formulae – Numerical integration using Trapezoidal and Simpson‟s 1/3 rules-Evaluation of double integrals by Trapezoidal and Simpson‟s 1/3 rules

UNIT - III Numerical solution of Ordinary Differential Equations **12**

Single step methods: Euler‟s method – Modified Euler‟s method – Fourth order Runge-Kutta method for solving first order equations – Multi step methods: Milne‟s – Bash forth predictor corrector methods for solving first order equations.

UNIT - IV Testing of hypothesis **12**

Sampling distributions –- Estimation of parameters –- Statistical hypothesis –- Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square for mean, variance and proportion - Contingency table (test for independent) -Goodness of fit.

Unit - V Design of Experiments **12**

One way and two way classifications -– Completely randomized design –- Randomized block design –- Latin square design - 2^2 factorial design.

Total: 60 Periods

Text Books:

1. Grewal B.S, and Grewal J.S "" Numerical methods in engineering and science "Khanna Publishers, 10th Edition, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund"s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference Books:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", Cengage Learning, 9th Edition, 2016.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, New Delhi, 3rd Edition, 2007.

Additional References:

3. https://pvpsitrealm.blogspot.com/2016/09/higher-engineering-mathematics-by-bs.html
4. https://reference.wolfram.com/language/tutorial/Numerical methods.html

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
Cos	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	-	-	-	-	-	-	-	-	1	1	
CO2	3	2	2	-	-	-	-	-	-	-	-	1	2	
CO3	3	3	1	-	-	-	-	-	-	-	-	1	1	
CO4	2	2	2	-	-	-	-	-	-	-	-	1	2	
CO5	3	3	2	-	-	-	-	-	-	-	-	1	2	
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination**
	IAE -I (7.5)	**IAE-II (7.5)**	**IAE-III (10)**	**(60)**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

20ME401	Strength of Materials	L	T	P	C
		3	2	0	4
Nature of course	Engineering Sciences				
Pre requisites	Engineering Mechanics				

Course Objectives

The course is intended to

1. Understand the concepts of stress, strain, principal stresses and principal planes.
2. Study the concept of shear force and bending moment due to external loads in determinate beams and their effect on stresses.
3. Learn the stresses and deformation in circular shafts and helical spring due to torsion.
4. Know the slopes and deflections in determinate beams by various methods.
5. Study the stresses and deformations induced in thin and thick shells

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Solve the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.	Apply
CO 2	Develop the load transferring mechanism in beams and stress distribution due to shear force and bending moment	Apply
CO 3	Apply basic equation of simple torsion in designing of shafts and helical spring	Apply
CO 4	Construct the slope and deflection in beams using different methods	Apply
CO 5	Model thin and thick shells for the applied internal and external pressures	Apply

Course Contents

Unit – I Stress, Strain and Deformation of Solids **12**

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains –Stresses on inclined planes – principal stresses and principal planes.

Unit – II Transverse Loading on Beams and Stresses in Beam **12**

Beams – types transverse loading on beams – Shear force and bending moment in beams – Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

Unit – III Torsion & Springs **12**

Torsion formulation, stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs

Unit – IV Deflection of Beams **12**

Double Integration method – Macaulay‟s method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell‟s reciprocal theorems.

Unit – V Thin Cylinders, Spheres and Thick Cylinders **12**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame‟s theorem.

Total : 60 Periods

Text Books

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 6th edition, 2018.
2. R. S. Khurmi, N. Khurmi “Strength of Materials”,S.Chand& Co., Ram Nagar, New Delhi, 26th edition, 2018.

Reference Books

1. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing „co. Ltd., New Delhi, 8th edition, 2020.
2. Hibbeler, R.C., "Mechanics of Materials" Pearson Education, Low Price Edition, 9th edition 2013
3. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 3rd edition, 2016

Additional References:

1. nptel.ac.in/courses/Webcoursecontents/.../strength%20of%20materials/homepage.htm
2. http://em2.yolasite.com/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	3	3	1									2	1	
CO 2	3	3	3	1									2	1	
CO 3	3	3	3	1									2	1	
CO 4	3	3	3	1									2	1	
CO 5	3	3	3	1									2	1	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial	5	
	Assignment	5	

Summative Assessment				
Bloom’s Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember				
Understand	20	20	20	40
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20ME402	Thermal Engineering	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Pre requisites	Thermodynamics				

Course Objectives

The course is intended to

1. Learn the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
2. Know the thermodynamic concepts into various thermal application likeAir Compressor
3. Introduce the thermodynamic concepts into various thermal application like IC engines.
4. Study the performance testing of IC engines
5. Learn the thermodynamic concepts into various thermal application like Gas Turbine

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Apply thermodynamic concepts to different air standard cycles and solve problems	Apply
CO 2	Solve problems in single stage and multistage air compressors	Apply
CO 3	Explain the functioning and features of IC engines, components and auxiliaries.	Apply
CO 4	Calculate performance parameters of IC Engines.	Apply
CO 5	Explain the flow in Gas turbines and solve problems.	Apply

Course Contents

Unit – I Gas and Steam Power Cycles **9**

Air Standard Cycles – Assumptions, Otto, Diesel, Dual and Brayton – Cycle Performance Analysis and Comparisons.

Unit – II Reciprocating Air Compressor **9**

Classification and comparison, working principle, work of compression - with and without clearance, efficiency. Multistage air compressor with Inter-cooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

Unit – III Internal Combustion Engines and Combustion **9**

IC engine – Classification, working, components and their functions. Theoretical and actual : Valve and port timing diagrams, p-v diagrams. Desirable properties and qualities of fuels. – Lean and rich mixtures. Combustion–Knocking – phenomena and control.

Unit – IV Internal Combustion Engine Performance and Systems **9**

Performance parameters and calculations- Morse and Heat Balance tests. Fuel Injection system. Lubrication and Cooling systems. Concepts of Supercharging and Turbo-charging.

Unit – V Gas Turbines **9**

Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combinations.

Total : 45 Periods

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Text Books

1. Rajput, "Thermal Engineering", Laxmi Publications, 10th edition, 2018
2. Rudramoorthy R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003.

Reference Books

1. Holman. J.P., "Thermodynamics", McGraw-Hill, 4th edition,1985.
2. Kothandaraman.C.P.,Domkundwar.S. and A.V.Domkundwar., "A course in Thermal Engineering", Dhanpat Rai & Sons, Fifth edition, 2002.
3. Arora.C.P, "Refrigeration and Air conditioning", McGraw Hill publication, 4th edition, 2021

Additional References:

1. https://ocw.mit.edu/courses/mechanical-engineering/
2. http://nptel.ac.in/courses/112104033/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	2	3	2										2	3	
CO 2	2	3	2										2	3	
CO 3	2	3	2										2	3	
CO 4	2	3	2										2	3	
CO 5	2	3	2										2	3	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Understand	Online Quiz	5	15
Apply	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember				
Understand	20	20	20	40
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20ME403	Manufacturing Technology – II	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Pre requisites	Manufacturing Technology-I				

Course Objectives

The course is intended to

1. Understand the various metal casting processes.
2. Gain knowledge on various operations of lathe machine.
3. Understand the process of making special components using special purpose machines.
4. Expose the students to various finishing processes.
5. Understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Explain the mechanism of material removal processes	Understand
CO 2	Constructional and operational features of special purpose machines.	Apply
CO 3	Construct the operational features of super finishing machines.	Apply
CO 4	Explain the types of computer numerical control machines and part programming.	Understand
CO 5	Summarize 3D printing methods and materials.	Understand

Course Contents

Unit – I Theory of Metal Cutting and Lathe **9**

Metal removal processes-Theory of metal cutting-Merchant‟s circle, chip formation Lathe: Specifications and parts of lathe - operations performed on lathe, accessories and Attachments.

Unit – II Special Purpose Machines **9**

Working principles of shaper, planer, slotting machine, Drilling machine - Drilling, Boring, Reaming and Tapping, Milling machines -gear milling, shaping and gear hobbing – Finishing of gears.

Unit – III Surface Finishing Processes **9**

Grinding wheel - specifications and selection, types of grinding process - cylindrical grinding, surface grinding, and centre less grinding, honing, lapping, super finishing, polishing and buffing.

Unit – IV Computer Numerical Controlled Machines **9**

Computer numerical control (CNC) of machine tools -: types, constructional details. Part programming – manual and computer aided part programming.

UNIT- V Additive Manufacturing Processes **9**

Introduction, Fused deposition modelling (FDM)- Selective Laser Sintering (SLS)- Stereolithography (SLA)- Selective Laser Melting (SLM) - Laminated object manufacturing. Merits, demerits and applications.

Total : 45 Periods

Text Books

1) Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 4th Edition, 2018.
2) Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters, 2014.

Reference Books

1) R.K. Jain, "Production Technology" Khanna Publishers, New Delhi, 2015.
2) Rajput, R.K., "A Textbook of Manufacturing Technology", Laxmi publications Ltd, New Delhi, 2nd edition, 2017.
3) Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", , Pearson publication, London, 4th edition, 2014.

Additional / Web References

4. https://nptel.ac.in/courses/112/105/112105126/
5. https://nptel.ac.in/courses/112/104/112104204/
6. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-me03/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	2	3	1										1	3	
CO 2	2	3	1										1	3	
CO 3	2	3	1										1	3	
CO 4	2	3	1										1	3	
CO 5	2	3	1										1	3	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Assignment	5	
	Tutorial	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (50)**
	IAE – 1 (7.5)	**IAE – 2 (7.5)**	**IAE – 3 (10)**	
Remember	10	10	10	20
Understand	20	20	40	50
Apply	20	20		30
Analyze				
Evaluate				
Create				

20ME404	Engineering Metrology	L	T	P	C
		3	0	2	4
Nature of course	Professional Core				
Pre requisites	Physics for Mechanical Sciences				

Course Objectives

The course is intended to

1. Learn the basics of measurement system and experimental errors.
2. Differentiate about linear, angular and optical measuring instruments.
3. Familiarize with surface roughness measurement and limits and fits.
4. Study about measurement of Displacement, Stress and Strain, and Force and Torque.
5. Know about measurement of Pressure, Fluid flow and Temperature

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Express the fundamentals concepts of Measuring system and Errors in Measurement.	Understand
CO 2	Outline the principles of linear and angular measurement tools used for industrial applications	Understand
CO 3	Summarize the working procedure of Laser Interferometer and Coordinate Measuring Machine (CMM).	Understand
CO 4	Demonstrate the techniques of form measurement used for industrial components	Understand
CO 5	Classify the various measuring instruments used to measure the power, flow and temperature.	Understand

Course Contents

Unit – I Basics of Metrology **9**

Introduction to Metrology – Need – Elements – Work piece, Instruments –Persons – Environment – their effect on Precision and Accuracy – Errors –Errors in Measurements – Types – Control – Types of standards

Unit – II Linear and angular Measurements **9**

Linear Measuring Instruments- Limit gauges – gauge design – terminology –concepts of interchange ability and selective assembly – Angular measuring instruments –Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator.

Unit – III Advances in Metrology **9**

Basic concept of lasers Advantages of lasers – laser Interferometers – types –DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of Coordinate Measuring Machine(CMM), Machine Vision System.

Unit – IV Form Measurements **9**

Principles and Methods of straightness measurement, Flatness measurement, Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications

Unit – V Measurement of power, flow and temperature **9**

Force, torque, power - mechanical , Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration.

Total : 45 Periods

Laboratory Component

S.No.	Name of the Experiment	CO Mapping	RBT
1	Calibration of vernier caliper and screw gauge	CO1	Apply
2	Calibration of height gage	CO1	Apply
3	Calibration of depth micrometer and bore gauge	CO2	Apply
4	Measurement of angles using bevel protractor	CO2	Apply
5	Calibration using sine bar	CO3	Apply
6	Measurement of gear parameters	CO3	Apply
7	Measurement of surface finish (machined)	CO4	Apply
8	Measurement of surface finish (polished)	CO4	Apply
9	Measurement of force and torque	CO5	Apply
10	Measurement of temperature	CO5	Apply

Total:30 Periods

Text Books

1. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2018.
2. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2021.

Reference Books

1. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education,6th edition 2020.
2. Charles Reginald Shotbolt, “Metrology for Engineers”, Cengage Learning EMEA, 5th edition 1990.
3. Raghavendra ,Krishnamurthy “Engineering Metrology & Measurements”, Oxford university press, 2016

Additional / Web References

1.https://www.mek.dtu.dk/english/Sections/MPP/Research/Manufacturing-metrology
2.https://tint.edu.in/tict-me-dept-laboratories/metrology-measurement-lab.html
3.http://www.metrology.wat.edu.pl/index.php/links/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3			2								1	1	3	
CO 2	3			2								1	1	3	
CO 3	3			2								1	1	3	
CO 4	3			2								1	1	3	
CO 5	3			2								1	1	3	
	3	High				2	Medium					1	Low		

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Summative assessment						
Bloom's Level	**Continuous Assessment**					**Final Examination (Theory) [50 marks]**
	Theory				**Practical**	
	IAE-I [7.5]	**IAE-II [7.5]**	**IAE-III [10]**	**Attendance [5]**	**Rubric based CIA [20 Marks]**	
Remember	20	10	10		20	20
Understand	30	40	40		80	80
Apply						
Analyse						
Evaluate						
Create						

20EE409	Electrical Drives and Microprocessor	L	T	P	C
		3	0	2	4
Nature of course	Engineering Sciences				
Pre requisites	Basics of Electrical and Electronics Engineering				

Course Objectives

The course is intended to

1. Learn steady state operation and transient dynamics of a motor load system
2. Study the different methods of starting and characteristics of drive motors
3. Learn the conventional speed control concepts of drive motors
4. Know solid state control of drive motors
5. Learn the industrial applications in drive motor control.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Summarize the basic drive system and interpret it for different types of loads.	Understand
CO 2	Show the motor situation during starting and braking.	Understand
CO 3	Develop control circuitry and devices for control of motor.	Apply
CO 4	Construct the circuit for control purpose along with its different configuration.	Apply
CO 5	Develop the Digital control system for drive applications.	Apply

Course Contents

Unit – I Dynamics of Electric Drives **9**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – Heating and cooling curves –classes of duty- Selection of drive motors with Load variation factors- Multi quadrant operation- Load equalization.

Unit – II Static Control and Characteristics of Motors **9**

Typical control circuits for motors – Types of AC and DC Starters- characteristics of various types of load and drive motors- Braking of Electrical motors.

Unit – III Conventional Speed Control of DC and AC Motors **9**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system- Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme.

Unit – IV Solid State Speed Control of DC and AC Motors **9**

Thyristor converter fed dc drives: - Single and Three phase operations- Chopper fed DC drives- Inverter fed AC drives- Cyclo converter fed AC drives.

Unit – V Digital Control and Drive Applications **9**

Digital techniques in speed control - Advantages and limitations –Microprocessor and PLC based control of drives- Solar and battery powered Drives- Introduction to traction Drives.

Total : 45 Periods

Laboratory components

S.No	List of Experiments	CO Mapping	Revised Blooms Taxonomy
1	Load test on DC Shunt motor	CO1	Understand
2	Load test on Three phase Squirrel cage induction motor	CO1	Understand
3	Four Quadrant operation of DC motor	CO2	Understand
4	Speed control of DC Shunt Motor	CO3	Understand
5	Speed Control of Three phase slip ring induction motor	CO3	Understand
6	Speed control of DC motor using 3ΦRectifier	CO4	Apply
7	chopper control of D.C. Motor for motoring and generating control	CO4	Apply
8	Speed control of 3 Φinduction motor using PWM inverter	CO4	Apply
9	PLC based drives	CO5	Apply
10	DSP based chopper fed DC motor drive	CO5	Apply

Total : 30 Periods

Text Books

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1. J. Gnanavadivel, “Electrical Drives and Control”, Anuradha Publications, 2004.
2. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall International, 1989.

Reference Books

1. Werner Leonhard, “Control of Electrical Drives”, Springer (India) Pvt. Ltd., 2006.
2. Bimal K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, 2015.
3. Ion Boldea and S. A. Nasar, “Electric Drives”, CRC Press LLC, New York, 3rd edition, 2016.

Additional / Web References

1. http://electrical-engineering-portal.com/download-center/books-and-guides/siemens-basics-ofenergy/basics-of-dc-drives.
2. https://www.joliettech.com/products/dc-variable-speed-drives/dc-drive-fundamentals/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	1						1	1		1	2	-	-
CO 2	3	2	1						1	1		1	2	-	-
CO 3	3	2	1						1	1		1	2	-	-
CO 4	3	2	1						1	1		1	2	-	-
CO 5	3	2	1						1	1		1	2	-	-
	3	High				2	Medium					1	Low		

Summative assessment						
Bloom's Level	**Continuous Assessment**					**Final Examination (Theory) [50 marks]**
	Theory				**Practical**	
	IAE-I [7.5]	**IAE-II [7.5]**	**IAE-III [10]**	**Attendance [5]**	**Rubric based CIA [20 Marks]**	
Remember	20	10	10		20	20
Understand	30	20	20		40	40
Apply		20	20		40	40
Analyze						
Evaluate						
Create						

20ME405	Thermal Engineering Laboratory-I	L	T	P	C
		0	0	2	1
Nature of course	**Professional Core**				
Pre requisites	Engineering Thermodynamics and Thermal Engineering				

Course Objectives

The course is intended to

1. Study the value timing-V diagram and performance of IC Engines
2. Conduct the performancetest on IC Engines
3. Examine the Flash Point and Fire Point of various fuels / lubricants.
4. Study the air compressor and blower along with factors influencing its performance
5. Study the performance of refrigeration cycle / Air conditioning systems

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Classify the IC engines and explain its working principle	Understand
CO 2	Determine the performance of I.C engines.	Apply
CO 3	Find the Flash Point and Fire Point of various fuels / lubricants.	Remember
CO 4	Explain the working of air compressor and blower along with factors influencing its performance	Understand
CO 5	Determine the cooling load for air conditioning and refrigeration systems.	Apply

S.No	List of Experiments	CO Mapping	Revised Blooms Taxonomy
1	Valve Timing and Port Timing diagrams.	CO 1	understand
2	Performance Test on 4 – stroke Diesel Engine.	CO 2	Apply
3	Heat Balance Test on 4 – stroke Diesel Engine.	CO 2	Apply
4	Morse Test on Multi-cylinder Petrol Engine.	CO 2	Apply
4	Retardation test to find Frictional Power of a Diesel Engine.	CO 2	Apply
5	Performance test on four stroke computerized diesel engine	CO 2	Apply
6	Find the Flash Point and Fire Point of various fuels / lubricants.	CO 3	Remember
7	Performance test on Air blower	CO 4	Apply
8	Performance test on a reciprocating air compressor	CO 4	Apply
9	Determination of COP of a refrigeration system	CO 5	Apply
10	Performance test on Air conditioning System	CO 5	Apply

Total : 30 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	1						1	1		1	1	3	
CO 2	3	2	1						1	1		1	1	3	
CO 3	3	2	1						1	1		1	1	3	
CO 4	3	2	1						1	1		1	1	3	
CO 5	3	2	1						1	1		1	1	3	
	3	High				2	Medium					1	Low		

Assessment based on Continuous and Final Examination			
Bloom's Level	**Continuous Assessment (50 marks) (Attendance – 5 marks)**		**Final Examination [50 marks]**
	Rubric based Continuous Assessment [25 marks]	**Model Examination [20 marks]**	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyze			
Evaluate			
Create			

20ME406	Manufacturing Technology Laboratory	L	T	P	C
		0	0	2	1
Nature of course	Professional Core				
Pre requisites	Manufacturing Technology - I				

Course Objectives

The course is intended to

1. Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry
2. Learn the main objective of this course is to emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes and tools used.
3. Know the course is delineated particularly to understand the conventional manufacturing processes like casting, metal forming, and welding process.
4. Study competency in understanding of machine tools and its working principles.
5. Know the design of machine tool structures and special features of machine tool design

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Select suitable process in lathe machine	Apply
CO 2	Choose different machine tools to manufacturing gears.	Apply
CO 3	Utilize different machine tools for finishing operations	Apply
CO 4	Make use of cutter grinder for sharpening of tools	Apply
CO 5	Select s suitable process for making key holes	Apply

S.No	List of Exercises	CO Mapping	Revised Blooms Taxonomy
1.	Facing and Step turning in lathe machine	CO 1	Apply
2.	Taper turning in lathe machine	CO 1	Apply
3.	Thread cutting in lathe machine	CO 1	Apply
4.	Contour milling using vertical milling machine	CO 2	Apply
5.	Spur gear cutting in milling machine	CO 2	Apply
6.	Helical Gear Cutting in milling machine	CO 2	Apply
7.	Plain Surface grinding	CO 3	Apply
8.	Cylindrical grinding	CO 3	Apply
9.	Tool angle grinding with tool and Cutter Grinder	CO 4	Apply
10.	Machining key hole in a slotting machine	CO 5	Apply
11.	Machining slot using a shaping machine	CO 5	Apply
			Total : 60 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	1		2				1	1		1	1	3	
CO 2	3	2	1		2				1	1		1	1	3	
CO 3	3	2	1		2				1	1		1	1	3	
CO 4	3	2	1		2				1	1		1	1	3	
CO 5	3	2	1		2				1	1		1	1	3	
	3	High				2	Medium					1	Low		

Assessment based on Continuous and Final Examination			
Bloom's Level	**Continuous Assessment (50 marks) (Attendance – 5 marks)**		**Final Examination [50 marks]**
	Rubric based Continuous Assessment [25 marks]	**Model Examination [20 marks]**	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyze			
Evaluate			
Create			

20MC401	**Soft Skill** (Common to All Branches of B.E., / B.Tech.)	L	T	P	C
		2	0	0	0
Nature of Course	Mandatory Course				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Improve language skills in personal and professional life.
2. Equip students with the vital communication and soft skills to succeed in the highly competitive international arena.
3. Focus on the fundamental soft skills and of their practical social and work place usage.
4. Learn to identify and overcome the barriers in interpersonal relationships.
5. Enhance employability skills and ensure career success.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Relate the significance and fundamental nature of soft skills.	Remember
CO2	Take part in a wide range of Public speaking and professional group discussions.	Understand
CO3	Plan one"s time effectively and productively, especially at work.	Apply
CO4	Make use of leadership skills to manage stress &conflict.	Apply
CO5	Organize presentation effectively and participate in interview with confidence.	Apply

Course Contents

Unit - I Introduction to soft skills and Interpersonal Communication **6**

An Introduction – Definition and Significance of Soft Skills; Interpersonal communication-types of interpersonal communication.

Unit - II Public Speaking and Oral Communication skills **6**

Public Speaking: Skills, Methods, Strategies Group Discussion: Importance, Planning, Elements.

Unit – III Time Management and Personality Development **6**

Time Management – concepts and essentials tips. Personality-development – meaning, SWOT analysis & goal setting- Stress and conflict management.

Unit – IV Leadership skills and Emotional intelligence **6**

Leadership skills: Concept of Leadership and honing Leadership skills- Problem-Solving Skills - Group and Ethical Decision-Making. Emotional Intelligence: Strategies to enhance Emotional Intelligence.

Unit-V Interview Skills **6**

Interviewer - Interviewee perspectives - Self Introduction and Presentation: Types, Content and Essential Tips–before, during and after a presentation, Overcoming Nervousness - Mock Interview.

Total:30 Periods

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Text Books

1. Managing Soft Skills for Personality Development–edited by B.N.Ghosh, McGraw Hill India, 2018.
2. English and Soft Skills–S.P. Dhanavel, Orient Black swan India, 2017

Reference Books:

1. Soft Skill Business and Professional Communication Book by Sutapa Banerjee,2016
2. Communication Skills Book by PushpLata and Sanjay Kumar,2015

WEB REFERENCE:

https://nptel.ac.in/courses/109/107/109107121/

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1								1	2	3		2			
CO2								1	2	3		2			
CO3								1	2	3		2			
CO4								1	2	3		2			
CO5								1	2	3		2			
	3	**High**				**2**	**Medium**				**1**	**Low**			

Bloom's Level	**Summative Assessment (Internal Mode)**	
	Assessment 1 (50 Marks)	**Assessment 2 (50 Marks)**
Remember	10	10
Understand	10	10
Apply	30	30
Analyze		
Evaluate		
Create		

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

20MEA01	Lean Manufacturing	L	T	P	C
		1	0	0	1
Nature of course	Employability Enhancement Course				
Pre requisites	Fundamentals of Mechanical Engineering				

Course Objectives

The course is intended to

1. Know the concepts of lean manufacturing and Tools.
2. Learn the total preventive maintenance and value stream mapping

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Make use of principles of lean manufacturing and lean tools	Apply
CO 2	Select the total preventive methods and value stream mapping	Apply

Course Contents

Unit I - Introduction to Lean Manufacturing & Lean Tools **7**

Introduction to seven waste and their narration; Global competition, Lean Manufacturing, Value flow and Muda, Muri and Mura, Need for Lean Manufacturing - Lean tool and techniques - Various tool of Lean Manufacturing, Fundamental blocks of Lean, 5S, Kaizen, Poka-yoke, Kanban, Line balancing

Unit II - Total Productive Maintenance (TPM) & Value Stream Mapping **8**

Need for TPM, Pillars of TPM, Implementation of TPM, Overall Equipment Effectiveness (OEE), OEE improvement- Sections of VSM - symbols of VSM- Current state mapping, Future state mapping, and application of VSM for an industrial process.

apping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1				2	3							2	1	3	
CO 2				2	3							2	1	3	
	3	High				2	Medium					1	Low		

Bloom's Level	Summative Assessment (Internal Mode)	
	Assessment 1 (50 Marks)	Assessment 2 (50 Marks)
Remember	10	10
Understand	10	10
Apply	30	30
Analyze		
Evaluate		
Create		

20MEA03	Plastics - Processing Tooling Assembly and Testing	L	T	P	C
		1	0	0	1
Nature of course	Employability Enhancement Course				
Pre requisites	Fundamentals of Mechanical Engineering				

Course Objectives

The course is intended to

1. To know the various plastic materials used in Automotive, home appliance and Medical fields
2. To understand the basic and advanced methods of plastic processing and the tooling and equipment used for it.
3. To learn various post processing requirements such as painting, foiling and pad painting.
4. To learn the various plastic joining processes
5. To learn about various plastic testing methods.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Understand the types of plastics, processing methods and tooling.	Understand
CO 2	Understand plastic assembly and testing methods	Understand

Course Contents

Unit I – Plastics - Processing and Tooling **8**

Introduction on plastics, Types of plastics - Thermo plastics, Thermo setting plastics, Applications in Automobiles, Home appliances etc. Basic concepts on plastics design, Mould flow analysis, Plastic processing - Preheating, Molding, Molding types - Injection molding, compression molding, Rot molding, 2K molding, Tooling - Core, cavity, inserts, Heating and cooling circuits, Tool materials, Molding machines - Types, tonnage and other specifications.

Unit II – Molding Defects Assembly and Testing **7**

Molding defects – War page, Catching, Weld line, burning, Sink marks etc., Method of avoiding defects, Post molding process - Annealing, Texturing, color foiling, pad painting, Painting, etc., Assembly of plastics - Ultrasonic welding, Heat sinking, Vibration welding. Testing of plastics - UV Testing, Scratch resistance, Flammability, resistance against chemicals, impact test.

Total: 15 Hours

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1				2	3							2	1	3	
CO 2				2	3							2	1	3	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Bloom's Level	**Summative Assessment (Internal Mode)**	
	Assessment 1 (50 Marks)	**Assessment 2 (50 Marks)**
Remember	10	10
Understand	10	10
Apply	30	30
Analyze		
Evaluate		
Create		

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

20ME501	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	2	0	4
Nature of Course	Professional Core (PC)				
Pre requisites	Strength of Materials				

Course Objectives

The course is intended to

- Familiarize with various steps involved in the design process
- Teach students how to apply the concepts of stress analysis, theories of failure and material selection
- Analyze, design and/or select commonly used machine components
- Familiarize principles involved in evaluating the shape and dimensions of a component
- Satisfy functional and strength requirements, standard practices and standard data and use catalogues and standard machine components

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Classify and explain the various steps involved in the design process, steady stresses and variable stresses in machine members.	Remembering
CO 2	Explain the Procedures involved in the design of shafts keys, splines and couplings.	Understand
CO 3	Demonstrate the knowledge on the designs of threaded fasteners, Knuckle joints, Cotter joints, welded and riveted joints.	Understand
CO 4	Design and optimize energy storing elements for the specific applications.	Applying
CO 5	Select appropriate rolling contact bearing, gasket and seal from the standard catalogue based on loads.	Understand

Course Contents

UNIT I STEADY AND VARIABLE STRESSES IN MACHINE MEMBERS 12

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties – Direct, Bending and torsional stress equations – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and 'C' frame- Factor of safety -theories of failure – Soderberg, Goodman and Gerber relations (variable loading) in design of various machine elements - stress concentration.

UNIT II DESIGN OF SHAFTS, KEYS AND COUPLINGS 12

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and keyways - Rigid and flexible couplings. Introduction to gear and shock absorbing couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 12

Threaded fasteners: Design of bolted joints including eccentric loading. Welded joints, riveted joints for structures - theory of bonded joints - Power screws.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 12

Types of springs – Design of helical and leaf springs. Rubber springs, theory of disc and torsional springs, Flywheels considering stresses in rims and arms for engines - Connecting Rods and crank shafts.

UNIT V DESIGN OF BEARINGS **12**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs, McKee's equation- Selection of Rolling Contact bearings.

Total : 45+15(Tutorial)=60 Periods

Note: Use of approved Design Data book is permitted for examination.

1. P.S.G. Tech., "Design Data", Data book for Engineers, Kalaikathir Achchagam, Coimbatore, 2018.

Text Books

1. A Textbook of Machine Design, RS Khurmi, S.Chand Publications.
2. Bhandari, V.B., "Design of Machine Elements", Tata McGraw-Hill education Pvt. Ltd., 3rd Edition, 2010.
3. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", Tata McGraw-Hill, 8th Edition, 2008.

Reference Books

1. Khurmi R S.,Gupta J K., "A Text book of Machine Design", Eurasia Pub. House Pvt. Ltd., 14th Ed., 2005.
2. Norton R.L, "Design of Machinery", McGraw-Hill Book co, 3rd Edition, 2004.
3. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
4. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003.
5. Sadhu singh, "Mechanical Machine Design", OBI Publishers, New Delhi,2013

Additional References

1. **NPTEL:** http://nptel.ac.in/courses/112105124/
   Prof.B.Maitietal, IIT kharagpur, Design of Machine Elements
2. https://www.coursera.org/learn/machine-design1
   Dr. Kathryn Wingateetal., Woodruff School of Mechanical Engineering,Machine Design Part I
3. **MOOC Courses** - https://www.mooc-list.com/tags/machine design

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2	3									3	3	
CO 2	3	2	3									3	3	
CO 3	3	2	3									3	3	
CO 4	3	2	3									3	3	
CO 5	3	2	3									3	3	
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20ME502	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core (PC)				
Pre requisites	Thermodynamics, Fluid Mechanics				

Course Objectives

The course is intended to

1. Familiarize conduction heat transfer mechanisms
2. Expose the mechanisms of free and forced convection
3. Develop the shape factor algebra for black body radiation and grey body radiation
4. Demonstrate the phase change heat transfer and calculate the performance of heat exchanging devices
5. Explain diffusion and convective mass transfer

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 6	Apply the principles of heat transfer in steady state conduction and determine the heat transfer characteristics.	Apply
CO 7	Analyze fluid flow systems and find heat transfer characteristics in forced and free convection processes.	Analyse
CO 8	Apply the principles of radiation in the heat exchange between black and grey bodies and establish heat transfer characteristics.	Apply
CO 9	Design heat exchangers and find the Heat transfer coefficient for boiling and condensation.	Analyse
CO 10	Find the mass transfer rate in diffusion and convective heat transfer coefficient or different applications.	Understand

Course Contents

UNIT I CONDUCTION HEAT TRANSFER 9

Basic concepts - mechanism of heat transfer. Conduction - Fourier's law, general differential equation in Cartesian and cylindrical coordinates, one dimensional steady state heat conduction, conduction through plane wall, cylinders and spherical systems. Composite Systems. Extended surfaces.

UNIT II CONVECTION HEAT TRANSFER 9

Basic concepts - Heat transfer coefficients, boundary layer concept. Forced convection – non dimensional numbers, external flow- flow over plates, cylinders and spheres, internal flow- flow through Horizontal pipe, laminar and turbulent flow. Free convection- non-dimensional numbers, flow over vertical plate, horizontal plate.

UNIT III RADIATION HEAT TRANSFER 9

Fundamentals of Radiation, Emission Characteristics - Irradiation, Total and Monochromatic radiation, Laws of Radiation - Planck, Wien's displacement, Kirchhoff, Lambert's cosine, Stefan–Boltzmann, Heat Exchange between Two Black Bodies and Gray Bodies, Concepts of Shape Factor, Emissivity, Radiation Shields.

UNIT IV PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Boiling: Pool Boiling Regimes, Determination of Heat Transfer Coefficient in Nucleate Boiling. Condensation: Film wise and Drop wise Condensation, Nusselt's Theory of Condensation on a Vertical Plate. Heat Exchangers: Classification of Heat Exchangers, Overall Heat Transfer Coefficient and Fouling Factor, Log Mean Temperature Difference (LMTD): parallel & counter flow, Effectiveness - NTU methods of analysis of heat exchangers.

UNIT V MASS TRANSFER 9

Basic concepts - Diffusion mass transfer - Fick's law of diffusion, Steady state molecular diffusion. Convective mass transfer- correlations. Heat and mass transfer analogy.

Note: Use of Standard Heat and Mass Transfer data book permitted

Total : 45 Periods

Text Books:

1. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International, 5th Edition, 2017.
2. Heat transfer, a practical approach, Yunus A- Cengel, 5th Edition, Tata Mc Graw Hill,2015.

Reference Books:

1. P.K.Nag, Heat Transfer, McGraw Hill Education, 3rd Edition, 2011.
2. Holman.J.P, Heat Transfer, TMH, 10th Edition, 2017.
3. Fundamentals of heat and mass transfer, Frank P. Incropera and David P. Dewitt, John Wiley and Son's,2005.
4. C.P Kothandaraman and S.Subramanyan, Heat and Mass Transfer data book, New Age International, 9th Edition, 2018.

Additional References

1. A Text book of Heat Transfer, John H Lienhard, 4th Edition.
2. NPTEL Heat Transfer course for Mechanical Engineering,http://nptel.ac.in/courses/112101097/
3. Heat Transfer, Chris Long & Naser Sayma, Bookboon.com, https://legacy.saylor.org/me204/Intro

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 6	3	2	1											3
CO 7		3	2											3
CO 8	2	3	1											3
CO 9	1	2	3											3
CO 10	3	2						1						3
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10		10	20
Understand	10	10	20	20
Apply	30	20		30
Analyse		20	20	30
Evaluate				
Create				

20ME503	COMPUTER AIDED MANUFACTURING	L	T	P	C
		3	0	0	3
Nature of course	**Professional Core (PC)**				
Pre requisites	**Manufacturing Technology - I, II**				

Course Objectives

The course is intended to

1. Educate students by covering different aspects of computer Aided Manufacturing.
2. Understand the different advances in manufacturing system like: GT and CAPP.
3. Summaries the different integrated production management system.
4. educate students to understand different advances in manufacturing system like: GT, CAPP and FMS
5. Familiarize the students by covering robotics and different material handling system required in manufacturing shop floor.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Recall about the classical production system, the components of CIM	Remembering
CO 2	Explain the concept of Computer Aided Process Planning (CAPP) and Material Requirements Planning (MRP)	Understand
CO 3	Illustrate the cellular manufacturing using Rank order, Clustering and Hollier method	Understand
CO 4	Explain Flexible Manufacturing system and applications of Automated Guided Vehicles in the implementation of CIM..	Understand
CO 5	Identify the configurations of Industrial Robots, and their part programming	Apply

Course Contents

Unit – I INTRODUCTION **9**

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerized elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production

Unit – II PRODUCTION PLANNING AND CONTROL AND COMPUTER AIDED PROCESS PLANNING **9**

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

Unit – III CELLULAR MANUFACTURING **9**

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

Unit – IV **FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)** **9**

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety

Unit – V **INDUSTRIAL ROBOTICS** **9**

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

Total : 45 Periods

Text Books

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008
2. Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2004.

Reference Books

1. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London, 1995.
2. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.
3. Rao. P, N Tewari &T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Company, 2000.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2			2							2		3
CO 2	3	2			2							2		3
CO 3	3	2			2							2		3
CO 4	3	2			2							2		3
CO 5	3	2			2							2		3
	3	**High**				**2**	**Medium**					**1**	**Low**	

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20ME504	DYNAMICS OF MACHINERY	L	T	P	C
		3	0	2	4
Nature of Course	Professional Elective (PE)				
Pre requisites	Kinematics of Machinery				

Course Objectives

The course is intended to

1. Understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms. Design the Gate and Riser System
2. Understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
3. Understand the effect of Dynamics of undesirable vibrations
4. Understand the principles in mechanisms used for speed control and stability control.
5. Understand the fundamentals of the theory of kinematics and dynamics of machines

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Calculate static and dynamic forces of mechanisms.	Remembering
CO 2	Calculate the balancing masses and their locations of reciprocating and rotating masses.	Understand
CO 3	Compute the frequency of free vibration.	Understand
CO 4	Compute the frequency of forced vibration and damping coefficient.	Understand
CO 5	Calculate the speed and lift of the governor and estimate the gyroscopic effect on automobiles, ships and airplanes.	Applying

Course Contents

UNIT I FORCE ANALYSIS **9**

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses- Dynamics of Cam- follower mechanism.

UNIT II BALANCING **9**

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.

UNIT III FREE VIBRATION **9**

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

UNIT IV FORCED VIBRATION **9**

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

UNIT V MECHANISM FOR CONTROL **9**

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes

Total : 45 Periods

Laboratory Components

S.No	Name of the Exercises	CO mapping	RBT
1.	Study of different type of Gears and Gear Mechanisms	CO1	Understand
2.	Study of various Kinematic mechanisms.-Oscillating cylinder, reciprocating engine mechanism, With worth quick return	CO1	Understand
3.	Study various CAM and Follower mechanism	CO1	Understand
4.	Balancing of reciprocating masses	CO2	Apply
5.	Balancing of rotating masses	CO2	Apply
6.	Determine the vibration frequency of beams	CO3	Apply
7.	Vibration of Spring mass system	CO3	Apply
8.	Determine whiling speed of shaft	CO4	Apply
9.	Determine range sensitivity of Governor apparatus - Watt, Porter, Proell and Hartnell governors.	CO5	Apply
10.	Study of gyroscopic effect and couple	CO	Apply

Text Books

1. F. B. Sayyad, “Dynamics of Machinery”, McMillan Publishers India Ltd., Tech-Max Educational resources, 2019.
2. Rattan, S.S, “Theory of Machines”, 5th Edition, Tata McGraw-Hill, 2019.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 5th Edition, Oxford University Press, 2016.

Reference Books

1. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014
2. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2008.
3. Khurmi, R.S.,”Theory of Machines”, 15th Edition, S Chand Publications, 2006.
4. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 2008.
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3	3	3	3							2	3	3
CO 2	3	3	3	3	3							2	3	3
CO 3	3	3	3	3	3							2	3	3
CO 4	3	3	3	3	3							2	3	3
CO 5	3	3	3	3	3							2	3	3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand Apply	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20ME505	HEAT TRANSFER LABORATORY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Thermodynamics, Heat Transfer				

Course Objectives

The course is intended to

1. Understand the various forms of heat transfer and their applications in real life problems.
2. Analyze the theoretical knowledge and apply it in conducting experiments in the forms of heat transfer.
3. Analyze different methods to calculate the heat transfer coefficient in various heat transfer problems.
4. Study the Radiation heat transfer for black body and grey body radiation.
5. Express the phase change heat transfer and calculate the performance of heat exchanging devices and refrigeration system.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Perform steady state conduction experiments to estimate thermal conductivity of different materials for plane, cylindrical and spherical geometries.	Apply
CO 2	Estimate heat transfer coefficients in forced convection, free convection.	Apply
CO 3	Perform radiation experiments: determine surface emissivity and Stefan-Boltzmann's constant and compare with theoretical values.	Apply
CO 4	Apply the heat transfer principle in heat exchangers and determine effectiveness of Parallel and Counter flow Heat Exchanger.	Apply
CO 5	Estimate heat transfer coefficient of Performance in Air Conditioning and Refrigeration System	Apply

Course Contents

S.No	List of Experiments	CO Mapping	Revised Blooms Taxonomy
Experiments on Conduction			
1.	Determination of overall heat transfer coefficient of Composite Wall.	CO1	Apply
2.	Determination of overall heat transfer coefficient of Lagged Pipe.	CO1	Apply
3.	Determination of Thermal Conductivity of given Metal Rod.	CO1	Apply
Experiments on Convection			

4.	Determination of heat transfer coefficient of Natural Convection in horizontal Cylinder	CO2	Apply
5.	Determination of heat transfer coefficient of Forced Convection.	CO2	Apply
6.	Determine the convective heat transfer coefficient in natural convection In Vertical Cylinder	CO2	Apply
7.	Determination of heat transfer coefficient of Pin-Fin (Natural and Forced Convection)	CO2	Apply
Experiments on Radiation			
8.	Determination of Stefan Boltzman Constant.	CO3	Apply
9.	Determination of Emissivity of test plate.	CO3	Apply
Experiments on Applications of heat transfer			
10.	Determination of effectiveness and overall heat transfer coefficient using Parallel and Counter flow Heat Exchanger	CO4	Apply
11.	Determine The Coefficient Of Performance In Air Conditioning Test Rig.	CO5	Apply
12.	Determine the Experimental Coefficient of Performance in Vapour Compression Refrigeration System	CO5	Apply

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3	2					2	1	2		2	2	3
CO 2	1	3	2					2	1	2		2	2	3
CO 3	1	3	2					2	1	2		2	2	3
CO 4	3	3	2					2	1	2		2	2	3
CO 5	3	3	2					2	1	2		2	2	3
	3-High				**2-Medium**				**1-Low**					

20ME506	COMPUTER AIDED MANUFACTURING LABORATORY	L	T	P	C
		0	0	2	1
Nature of Course	Professional Core (PC)				
Pre requisites	Manufacturing Technology Laboratory – II				

Course Objectives

The course is intended to

1. Study the features of CNC Machine Tool.
2. Expose students to modern control systems (Fanuc, Siemens etc.,)
3. Know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre,
4. Understand the operations CNC milling machine and explore its applications
5. Study the advancement of Rapid prototyping by using the CAM tools

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Familiarize CNC machines, tools and working conditions along with programming	Understand
CO 2	Write external turning CNC Programs (Including Threading and Grooving)	Apply
CO 3	Write external turning CNC Programs (Including Drilling, Boring and Internal Threading)	Apply
CO 4	Write external milling CNC Programs (Including Contouring and Pocketing)	Apply
CO 5	Execute the Mirroring command and demo with real time applications , Rapid Prototyping	Apply

Courses to be covered for CAM

Introduction to CNC Machines and its operations

Lecture No	Descriptions	Course Outcomes	Blooms taxonomy
1.	Lathe Coordinate system & Operations	CO1	Understand
2.	G & M codes	CO1	Understand
3.	CNC lathe – facing & Turning operation	CO1	Understand
4.	Taper & Step Turning operation	CO2	Apply
5.	External Threading Operation	CO2	Apply
6.	Grooving Operation	CO2	Apply
7.	Drilling operation & Boring Operation	CO3	Apply
8.	Internal Threading Operation	CO3	Apply
9.	CNC Milling Coordinates & Operation introduction	CO3	Apply
10.	Contouring operation	CO4	Apply
11.	Pocketing operation	CO4	Apply
12.	Drilling operation	CO4	Apply
13.	Mirroring command	CO5	Apply
14.	CNC lathe and Milling Demo	CO5	Apply
15.	Study of advanced CAM Software, Rapid Prototyping	CO5	Apply

Total: 30 Periods

Mapping of Course Outcomes

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 11	3	3	3	3	3							3	3	3
CO 12	3	3	3	3	3							3	3	3
CO 13	3	3	3	3	3							3	3	3
CO 14	3	3	3	3	3							3	3	3
CO 15	3	3	3	3	3							3	3	3
	3-High				**2-Medium**				**1-Low**					

Assessment based on Continuous and Final Examination			
Bloom's Category	**Continuous Assessment (50 marks) (Attendance – 5 marks)**		**Final Examinations (FE)**
	Rubric based Continuous Assessment [25 marks]	**Model Examination [20 marks]**	**50**
Remember			
Understand	20	20	20
Apply	80	80	80
Analyse			
Evaluate			
Create			

VI SEMESTER

20ME601	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	2	0	4
Nature of Course	Professional Core (PC)				
Pre requisites	Strength of Materials, Design of Machine Elements				

Course Objectives

The course is intended to

1. Apply the principles and procedure for the design of power transmission components.
2. Apply the standard procedure available for design of transmission system terms.
3. Learn to use standard data and catalogues.
4. Select / design / manufacture drive systems for a wide variety of driven loads to a given performance specification.
5. Design, manufacturing and quality assurance of selected power transmission components.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Select, design and analyze flexible drives	Remembering
CO 2	Design of spur and Helical gears based on Lewis and Buckingham equation and gear life	Understand
CO 3	Design of bevel and Worm gears based on Lewis and Buckingham equation and gear life	Understand
CO 4	Design and analyze the multi speed gear box	Applying
CO 5	Design and analyze the frictional drives.	Applying

Course Contents

UNIT I SELECTION OF FLAT ,V BELTS AND CHAINS **12**

Selection of flat belts and pulleys, selection of V belt and pulleys, wire ropes and pulleys, selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

UNIT II DESIGN OF SPUR AND HELICAL GEARS **12**

Review of gear fundamentals, interference, force analysis in gears, determining dimensions of a spur gear pair. Design of helical gears-parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, determining dimension of helical gear pair.

.

UNIT III DESIGN OF BEVEL AND WORM GEARS **12**

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.

UNIT IV DESIGN OF GEARBOXES **12**

Geometric progression – Standard step ratio – Ray diagram, kinematics layout –Design of sliding mesh gear box – Design of multi speed gear box for machine tool applications – Constant mesh gear box – Speed reducer unit – Variable speed gear box.

UNIT V DESIGN OF FRICTIONAL DRIVES **12**

Clutches – role of clutches, positive and gradually engaged clutches, toothed claw clutches, design of single plate and multiple plate clutches, variable speed drives, types and selection. Role of brakes-types of brakes self-energizing and de-energizing brakes. Design of internally expanding shoe brakes – calculation of heat generation and heat dissipation in brakes.

Total : 45+15 (Tutorial)=60 Periods

Note: Use of approved Design Data book is permitted for examination.

1. P.S.G. Tech., "Design Data", Data book for Engineers, Kalaikathir Achchagam, Coimbatore, 2018.

Text Books

1. Bhandari, V.B., "Design of Machine Elements", Tata McGraw-Hill education Pvt. Ltd., 3rd Edition, 2010.
2. Richard Bundya and Shigley, "Mechanical Engineering Design", McGraw Hill Book Company.
3. Richard G. Budynas, J.KeithNisbett, "Shigley's Mechanical Engineering Design", McGraw-Hill Education (India) P Ltd., 9th Edition, 2011.

Reference Books

1. Khurmi R S.,Gupta J K., "A Text book of Machine Design", Eurasia Pub. House Pvt. Ltd., 14th Ed., 2005.
2. Norton R.L, "Design of Machinery", McGraw-Hill Book co, 3rd Edition, 2004.
3. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
4. Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2010.
5. Sadhu singh, "Mechanical Machine Design", OBI Publishers, New Delhi,2013.

Additional References

1. **NPTEL:** http://www.nptelvideos.in/2012/12/design-of-machine-elements.html
   Prof.G. Chakraborty, Department of Mechanical Engineering, IIT Kharagpur, Design of Brakes.
2. 2. http://freevideolectures.com/Course/2353/Power-Systems-Analysis/11,Prof. A.K. Sinha, IIT Kharagpur, Transmission Systems.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	3									3	3	
CO 2	3	2	3									3	3	
CO 3	3	2	3									3	3	
CO 4	3	2	3									3	3	
CO 5	3	2	3									3	3	
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20ME602	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core (PC)				
Pre requisites	Strength of Materials, Numerical Methods				

Course Objectives

The course is intended to

1. Understand the basic concepts of FEA and Analytical methods
2. Formulate stiffness matrix problems for rod, beam and truss.
3. Formulate 2D plane stress, strain and axisymmetic problems
4. Write the shape function for 1D,2D elements and apply Gauess quadrature methods
5. Solve various heat transfer problems

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Explain the various applications of FEA and basic methods	Understand
CO 2	Solve linear 1D structural rod, beams and Truss problems	Applying
CO 3	Solve two dimensional Structural problems FEM method	Applying
CO 4	Derive shape functions for 4 and 8 node quadrilateral, 6 node triangle elements and apply numerical integration to solve; 1D and 2D; stiffness integrations	Applying
CO 5	Analyse heat conduction and convection heat transfer problems and familiarize FEA software	Applying

Course Contents

UNIT I INTRODUCTION TO FINITE ELEMENT ANALYSIS 9

History, Applications, merits, demerits, and steps followed in FEA, Engineering Analysis, Convergence criteria, Governing Equations, Boundary and Initial Conditions, Weak and Variational formulation, Gauess Elimination method.

UNIT II ONE DIMENSIONAL PROBLEMS 9

Stiffness matrix methods, One dimensional elements, Derivation of stiffness equation of problems (Rod,BEAM,Truss) and problems , Vibration problems (Rod,BEAM)

UNIT III TWO DIMESNIONAL PROBLEMS 9

Two dimensional Elements (Plane stress, plane strain, Axisymmetric), Derivation of shape function, strain, stress for CST element and simple Problems.

UNIT IV ISOPARAMETRIC ELEMENTS 9

Shape function for 1D ,2D elements , Sub parametric, super parametric and Isoparametric elements, Numerical Integration with Gauess quadrature.

UNIT V FIELD PROBLEMS AND FEA SOFTWARES 9

Heat transfer problems, conduction, convection, thermal fin, Thermal stress, heat generation problems. Various Features of FEM Software.

Total : 45 Periods

Text Books

1. J. N. Reddy, " An Introduction to Finite Element Methods", 4e, McGraw Hill, 2015
2. S.S.Rao , "The finite element method in Engineering",3e, Butterworth and Heinnemann, 2015

Reference Books

1. Robert Cook , "Concepts and applications of finite element analysis", 4e, John Wiley and sons,2009
2. Tirupathi K. Chandrupatla and Ashok D.Belegundu, "Introduction to finite elements in engineering",3e, Pearson Education,201

Additional References

1. **NPTEL** - https://nptel.ac.in/courses/112/104/112104193/
2. https://ocw.mit.edu/courses/mechanical-engineering/2-092-finite-element-analysis-of-solids-and-fluids-i-fall-2009/
3. **MOOC Courses** - https://www.mooc-list.com/tags/finite-element

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3	2	2	2						2		3	3
CO 2	2	3	2	2	2						2		3	3
CO 3	3	3	2	2	2						2		3	3
CO 4	3	3	2	2	2						2		3	3
CO 5	3	3	2	2	3						2		3	3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20ME603	MECHATRONICS ENGINEERING	L	T	P	C
		3	0	2	4
Nature of Course	Professional Core (PC)				
Pre requisites	Electrical Drives and Microprocessor				

Course Objectives

The course is intended to

1. Understand the various stages of mechatronics system and sensors.
2. Familiarize Microprocessor and its components
3. Interface microprocessor with various input and output devices
4. Learn various PLC components and its Functions
5. Study the various applications of Mechatronics system

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology	Understand
CO 2	Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.	Understand
CO 3	Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing	Understand
CO 4	Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering	Understand
CO 5	Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies	Applying

Course Contents

UNIT I INTRODUCTION **9**

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

UNIT II MICROPROCESSOR AND MICROCONTROLLER **9**

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE **9**

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface

UNIT IV ROGRAMMABLE LOGIC CONTROLLER **9**

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN **9**

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier

Total : 45 Periods

Laboratory Components

S.No	Name of the Exercises	CO mapping	RBT
1.	Study of various sensors and Transducers	CO1	Understand
2.	8085 Microprocessor 8 bit Addition and subtraction	CO2	Understand
3.	8085 Microprocessor 8 bit Multiplication and Division	CO2	Understand
4.	8085 Microprocessor 8 bit ascending and descending order	CO2	Apply
5.	8085 Microprocessor 8 bit binary to hexadecimal conversion	CO2	Apply
6.	8085 Microprocessor 8 bit hexadecimal to binary conversion	CO2	Apply
7.	8085 interfacing to stepper motor	CO3	Apply
8.	8085 interfacing to Traffic light Control	CO3	Apply
9.	Study of simple PLC programme	CO4	Apply
10.	Study of various mechatronics applications	CO5	Apply

Text Books

1. William Bolton, “Mechatronics”, Prentice Hall, 2016
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 6th Edition, Prentice Hall, 2014.

Reference Books

1. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 2018.
2. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
4. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007.
5. Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 2007.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3	3		3							2	3	3
CO 2	3	3	3		3							2	3	3
CO 3	3	3	3		3							2	3	3
CO 4	3	3	3		3							2	3	3
CO 5	3	3	3		3							2	3	3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20ME604	MODELLING LABORATORY	L	T	P	C
		0	0	2	1
Nature of Course	Professional Core (PC)				
Pre requisites	Computer Aided Machine Drawing Laboratory				

Course Objectives

The course is intended to

1. Understand the fundamentals of 3D modelling software systems
2. model the machine components
3. Invent a mechanical components such bearing, gear ,piston, connecting rod
4. Analysis various components Wind Turbine, pump and Motor bike.
5. Model the Car and aircraft components

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Familiarize 3D Modelling Software	Understand
CO 2	Model basic machine Components	Apply
CO 3	Design a mechanical components such bearing, gear ,piston, connecting rod	Apply
CO 4	Create various construction , Turbine components	Apply
CO 5	Create Automobile and aircraft components	Apply

Courses to be covered

Creation of 3D assembly model of following machine elements using 3D Modelling software

Lecture No	Descriptions	Course Outcomes	Blooms taxonomy
11.	Introduction of 3D Modelling software	CO1	Understand
12.	Flange Coupling	CO1	Understand
13.	Plummer Block	CO1	Understand
14.	Screw Jack	CO2	Apply
15.	Lathe Tailstock	CO2	Apply
16.	Universal Joint	CO2	Apply
17.	Bearing roller, ball	CO3	Apply
18.	Gear design (spur, helical, etc.)	CO3	Apply
19.	Different valve design	CO3	Apply
20.	Connecting rod, Piston	CO3	Apply
21.	Sheet metal design	CO4	Apply

22.	Construction equipment design	CO4	Apply
23.	Wind Turbine blade design	CO4	Apply
24.	Motor bike design	CO5	Apply
25.	3D Car Modelling	CO5	Apply
26.	3D Aircraft Modelling	CO5	Apply
27.	Pump	CO5	Apply

Total: 30 Periods

Mapping of Course Outcomes

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3	3	3	3							3	3	3
CO 2	3	3	3	3	3							3	3	3
CO 3	3	3	3	3	3							3	3	3
CO 4	3	3	3	3	3							3	3	3
CO 5	3	3	3	3	3							3	3	3
	3-High				**2-Medium**				**1-Low**					

Assessment based on Continuous and Final Examination			
Bloom's Category	**Continuous Assessment (50 marks) (Attendance – 5 marks)**		**Final Examinations (FE)**
	Rubric based Continuous Assessment [25 marks]	**Model Examination [20 marks]**	**50**
Remember			
Understand	20	20	20
Apply	80	80	80
Analyse			
Evaluate			
Create			

20ME605	MINI PROJECT	L	T	P	C
		0	0	2	1

Nature of Course	Employability Enhancement Course
Pre requisites	Knowledge in Mechanical Engineering

Course Objectives

The course is intended to

1. Develop skills to formulate a technical project.
2. Give guidance on the various tasks of the project and standard procedures.
3. Give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
4. To get hands on training in the fabrication of one or more components of a complete working model, this is designed by them.
5. Provide guidelines to prepare technical report of the project.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Demonstrate the working model of the machine element or the mechanical product.	Understand
CO 2	Identify technical ideas, strategies and methodologies.	Apply
CO 3	Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.	Apply
CO 4	Test and validate through conformance of the developed prototype and analysis the cost effectiveness.	Analyse
CO 5	Prepare technical report and oral presentations.	Understand

Guideline for Review and Evaluation

1. The students may be grouped into 2 to 4 and work under a project supervisor.
2. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry.
3. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department.
4. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 30 PERIODS

	Continuous Assessment [50 marks]						Final Viva Voce Examination [50 marks]
	Review I [10]	Review II [10]	Review III [10]	Publication [10]	Report [10 Marks]	Total [50]	
Marks	100	100	100	10	10	50	50

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 6	3	3	1		1		1	2	2	2	2	1	3	3
1.	3	3	1		2		1	2	2	2	2	1	3	3
2.	3	3	1		2		1	1	2	2	2	1	3	3
3.	3	3	1		2		1	1	2	2	2	1	3	3
4.	3	3	1		1		1	1	2	2	2	1	3	3
	3-High				**2-Medium**				**1-Low**					

20ME606	INTERNSHIP	L	T	P	C
		0	0	2	1
Nature of Course	Employability Enhancement Courses				
Pre requisites	Nil				

Course Objectives

1. To encourage the students to study advanced engineering developments
2. To prepare and present technical reports.
3. To encourage the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.
4. To understand work ethic and commitment in a work-based environment
5. To gain practical experience in the workplace before receiving their undergraduate degrees

Course Outcomes

Upon successful completion of the internship, students should be able to:

1. Communicate a practical understanding of how a business actually operates
2. Demonstrate the ability to integrate and apply theoretical knowledge and skills develop in various courses to real-world situations in a business organization
3. Exhibit the ability to effectively work in a professional environment and demonstrate work ethic and commitment in a work-based environment
4. Demonstrate the ability to successfully complete internship assignments.
5. Develop the technology with sustainability long through societal relevance.

Guidelines for Internship

1. All the students need to go for internship for minimum of **2 weeks**.
2. Students can take mini projects, assignments, case studies by discussing it with concerned authority from industry and can work on it during internship.
3. All students should compulsorily follow the rules and regulations as laid by industry.
4. Every student should take prior permissions from concerned industrial authority if they want to use any drawings, photographs or any other document from industry.
5. Student should follow all ethical practices and SOP of industry
6. Students have to take necessary health and safety precautions as laid by the industry.
7. Student should contact his /her academic guide from college on weekly basis to communicate the progress.
8. Each student has to prepare internship report in consultation with the faculty.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				3	3	2	1	3	2	2
CO2	3	3	3	3	3				3	3	2	1	3	2	2
CO3	3	3	3	3	3				3	3	2	1	3	2	2
CO4	3	3	3	3	3				3	3	2	1	3	2	2
CO5	3	3	3	3	3				3	3	2	1	3	2	2
	3	High				2	Medium					1	Low		

One Credit Course

20MEA05	CNC PROGRAMMING	L	T	P	C
		1	0	0	1
Nature of course	Employability Enhancement Course				
Pre requisites	Fundamentals of Mechanical Engineering				

Course Objectives

The course is intended to

1. Learn the CNC lathe Programming and machine
2. Learn the CNC milling programming and Machine

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Write the CNC lathe program and operate the machine	Apply
CO 2	Write the CNC Milling program and operate the machine	Apply

Course Contents

Unit I - Introduction to CNC lathe Programming **8**

Lathe Coordinate system & Operations, G & M codes, CNC lathe – facing & Turning operation Taper & Step turning operation, External Threading Operation, Grooving Operation, Drilling operation & Boring Operation, Internal Threading Operation, machine Practice

Unit II - Introduction to CNC Milling Programming **7**

CNC Milling Coordinates & Operation introduction, contouring operation, pocketing operation Drilling operation, Mirroring command, sub program, machine Practice

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	3	3	3							3	3	3	
CO 2	3	3	3	3	3							3	3	3	
	3	High				2	Medium					1	Low		

Bloom's Level	Summative Assessment (Internal Mode)	
	Assessment 1 (50 Marks)	**Assessment 2 (50 Marks)**
Remember	10	10
Understand	10	10
Apply	30	30
Analyze		
Evaluate		
Create		

Stream - I
Design Engineering

20MEE01	DESIGN THINKING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Engineering Graphics				

Course Objectives

The course is intended to

1. Familiarize design thinking process
2. Understand the concepts of personas
3. Create idea generation
4. Apply the concepts of design thinking in firm
5. Implement design thinking specific contexts

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Explain the design thinking process	Understand
CO 2	Use various mapping tools	Applying
CO 3	Build design thinking ideas	Applying
CO 4	Apply design thinking ideas to the firm	Applying
CO 5	Execute design thinking for specific contexts	Applying

Course Contents

UNIT I INTRODUCTION TO DESIGN THINKING **9**

The Concept of Design Thinking and Its Role within NPD and Innovation, A Framework of Design Thinking, Design Thinking as a Nonlinear Process, The Principles and the "Mindset" of Design Thinking. Nine Criteria of an Inspirational Design Brief, Writing the Inspirational Design Brief, Research Findings about Inspirational Design Briefs.

UNIT II POWERFUL TOOL FOR DESIGNERS **9**

Defining Personas, The Importance of Personas, Creating Personas, Illustrative Application of Personas, Customer Experience Mapping, Inputs to the Experience Map, The Experience Mapping Process, The Experience Map as a Springboard to Innovative Solutions.

UNIT III DESIGN THINKING TO BRIDGE RESEARCH AND CONCEPT DESIGN **9**

Challenges in Idea Generation, The Need for a Systematic Method to Connect to the User, The Visualize, Empathize, and Ideate Method, The Importance of Visualizing and Empathizing before Ideating, Design Heuristics, Design Heuristics for Idea Generation, Evidence of the Value of the Design Heuristics Tool.

UNIT IV DESIGN THINKING WITHIN THE FIRM **9**

Integrating Design into the Fuzzy Front End of the Innovation Process , Challenges in the FFE, Design Practices and Tools for Assisting in Problem Definition, Design Practices and Tools for Assisting in Information Management, How to Integrate Design Professionals in FFE.

UNIT V DESIGN THINKING FOR SPECIFIC CONTEXTS **9**

Products, Services, and Experiences, How to Design for Compelling Service Experiences, Services that Sing and Dance, Designing a Service Experience Is Never Finished

Total : 45 Periods

Text Books

1. Michael G.Luchs, Scott swan, abbie griffin, “Design Thinking: New Product Development Essentials from the PDMA”, John Wiley & Sons, 2016.
2. Moritz Gekeler, “A practical guide to design thinking”, Friedrich-Ebert-Stiftung India Office, 2019.

Reference Books

1. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand –Improve –Apply", Springer, 2011
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advan tage", Harvard Business Press , 2009.
3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

Additional References

1. **NPTEL** - https://nptel.ac.in/courses/110/106/110106124/
2. **MOOC Courses** - https://www.mooc-list.com/tags/design-thinking

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3	3		3							3	3	3
CO 2	3	3	3		3							3	3	3
CO 3	3	3	3		3							3	3	3
CO 4	3	3	3		3							3	3	3
CO 5	3	3	3		3							3	3	3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20MEE02	PRODUCT DESIGN	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core (PE)				
Pre requisites	NIL				

Course Objectives

1. This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes
2. The student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools, demonstrate technical competency in practice Function effectively in an industrial and academic environments.
3. Engage in professional ethics and development.
4. Enrich their society and environment through their skills.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 6	Discuss the concept and stages involved in a generic product development process	Remembering
CO 7	Identify the customer needs and establish the product specifications.	Understand
CO 8	Identify concept generation activities and apply design for manufacturing concepts in estimating manufacturing costs	Understand
CO 9	Explain the concepts of product architecture and identify the ways to reduce the product cost	Understand
CO 10	Apply principles of prototyping in product development economics and effectively manage the product development projects	Applying

Course Contents

UNIT I BASICS OF PRODUCT DESIGN **9**

Introduction – Classification, Specifications of Products, Product life cycle. Introduction to product design & development, A generic development process, concept development: the front-end process, adapting the generic product development process, the AMF development process, the AMF organization

UNIT II IDENTIFYING CUSTOMER NEEDS - PRODUCT SPECIFICATIONS **9**

Gathering raw data from customers, interpreting raw data in terms of customer needs, organizing the needs into a hierarchy, establishing the relative importance of the needs and reflecting on the results and the process. Specifications, establish specifications, establishing target specifications, setting the final specifications

UNIT III CONCEPT GENERATION, SELECTION & TESTING **9**

Overview of methodology, concept screening, concept scoring, caveats. Purpose of concept test, choosing a survey population and a survey format, communicate the concept, measuring customer response, interpreting the result, reflecting on the results and the process.

UNIT IV PRODUCT ARCHITECTURE -DESIGN FOR MANUFACTURING & ASSEMBLY **9**

Meaning of product architecture, establishing the architecture, platform planning, related system level design issues. Assessing the need for industrial design, industrial design process, managing the industrial design process. Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

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UNIT V PROTOTYPING , PRODUCT DEVELOPMENT ECONOMICS **9**

Prototyping basics, principles of prototyping technologies, planning for prototypes, Elements of economic analysis. Sensitive analysis, project trade-offs, qualitative analysis. Understanding and representing task, baseline project planning, accelerating projects, project execution, project evaluation.

Total : 45 Periods

Text Books

1. Karl T Ulrich, Steven D Eppinger , " Product Design & Development." Tata McGrawhill New Delhi 2011
2. Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1 / e 2004 , Pearson Education New Delhi.

Reference Books

1. David G Ullman, "The Mechanical Design Process." McGrawhill Inc Singapore 2017 N J M Roozenberg , J Ekels , N F M Roozenberg " Product Design Fundamentals and Methods ." John Willey & Sons 1995
2. L D Miles "Value Engineering."
3. Hollins B & Pugh S "Successful Product Design." Butter worths London.

Additional References

1. NPTEL: https://onlinecourses.nptel.ac.in/noc17_me16/preview
2. https://nptel.ac.in/courses/112107078/37

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 6	3	2	2		2							3	3	3
CO 7	3	2	2		2							3	3	3
CO 8	3	2	2		2							3	3	3
CO 9	3	2	2		2							3	3	3
CO 10	3	2	2		2							3	3	3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20MEE03	TOOL AND DIE DESIGN	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Manufacturing Technology 1&2				

Course Objectives

The course is intended to

1. Develop capability to design and select single point and multipoint cutting tools for various machining operations.
2. Exposure to variety of locating and clamping methods available.
3. Enable the students to design jigs and fixtures for simple components.
4. Expose the students to the design/selection procedure of press tools and die casting dies.
5. Learn the inputs, concepts and requirements for die design.

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	The knowledge of tool design and The concepts and principles used in Tool Design.	Understand
CO 2	Design a single point or multi point cutting tool to machine a required job.	Understand
CO 3	Design a location and clamping system for a given component.	Applying
CO 4	Design die and punch for blanking, piercing, drawing and bending operations.	Understand
CO 5	Interpret the technical details based on the drawing dies and die casting	Applying

Course Contents

UNIT I INTRODUCTION TO TOOL DESIGN **9**

Tooling, requirements of a tool designer, general tool design procedure, tool engineering functions and its importance to enhance productivity and quality. Review of cutting tool materials. Tool angles and signature, Carbide inserts grades - ISO designation and applications, tool holders for turning-ISO designation. Solid type tool, brazed tip tool, throw away indexable insert types, coated carbides and chip breakers.

UNIT II DESIGN OF CUTTING TOOLS **9**

Design of single point cutting tools: Design of shank dimensions using strength and rigidity considerations for rectangular, square and round cross section and selection of tool geometry. Design of Multi Point Cutting Tools: Types of drills, Drill bit design - elements like back taper, web thickness, land width, margin, flute length and cross section and selection of tool geometry. Re-sharpening of drill bit. Tool holders for milling, different tapers used for mounting tool holders in milling, ISO designation. Tool mounting systems. Design of milling cutters: Design of elements like number of teeth and height, circular pitch, body thickness, chamfer width, fillet radius and selection of tool geometry. Profile sharpened and form relieved milling cutters. Re-sharpening of side and face milling cutter and end mill.

UNIT III JIGS AND FIXTURES **9**

Functions and differences between jigs and fixtures, advantages in mass production, design principles, economics of jigs and fixtures. Location: 3-2-1 Principle of location, different types of locating elements. Clamping: Principles of clamping, types of clamping devices, and power clamping. Drill bushes; Drill jigs: different types, exercises of designing jigs for simple components. Fixture Design: Turning fixtures, milling fixtures, grinding fixtures, fixturing for CNC machining centers, and modular fixtures. Design exercises on fixtures for turning and milling for simple components

UNIT IV PRESS TOOLS& BENDING DIES **9**

Press tools: Classification and working of power presses. Concept and calculations of press tonnage and shut height of a press, components of a simple die, press tool operation, die accessories, shearing action in punch & die, clearance, shear on punch and die, Centre of pressure, and strip layout. Simple, progressive, compound, combination and inverted dies. Design problems on blanking and piercing dies for simple components. Bending dies – Introduction, bend allowance, spring back, edge bending die design.

UNIT V DRAWING DIES& DIE CASTING **9**

Drawing dies – Single action, double action and triple action dies, factors affecting drawing and drawing die design. Design of drawing dies for simple components. Die casting: Die casting alloys, terminology-core, cavity, sprue, slug, fixed and movable cores, finger cams, draft, ejector pins and plates, gate, goose nozzle, over-flow, patten, plunger, runner, vent, water-line etc. Types of Dies: Single cavity, multi cavity dies, combination dies, unit dies, advantages and disadvantages of types of dies; finishing, trimming and inspection of die casting components, safety, and modern trends in die casting dies.

Total : 45 Periods

Text Books

1. Cyril Donaldson, George H. Lecain,V.C.Goold, “Tool Design”, McGraw Hill Education, 5th edition,2017.
2. P.N.Rao, “Manufacturing technology”, McGraw Hill Education, 4th edition, 2018.

Reference Books

1. P.H.Joshi, “Jigs and Fixtures”, McGraw Hill Education, 3rd edition, 2017.
2. John.G. Nee, William Dufraine, John W.Evans, Mark Hill, “Fundamentals of Tool Design”, Society of Manufacturing Engineers, 2010.
3. Frank W.Wilson, “Fundamentals of Tool Design”,PHI publications.
4. Kempester M.H.A., “An introduction to Jig and Tool design”, VIVABooksPvt.Ltd., 2004.

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3	3		3						3	2	3	3
CO 2	3	3	3		3						3	2	3	3
CO 3	3	3	3		3						3	2	3	3
CO 4	3	3	3		3						3	2	3	3
CO 5	3	3	3		3						3	2	3	3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20MEE04	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Impart knowledge on the science, use and application of hydraulics system as fluid power in Industry.
2. Acquire the concept of control and regulation elements in hydraulic system
3. Learn the procedure to design hydraulic circuits for different application
4. Study the fundamentals of pneumatic system and circuits
5. Understand the procedure for installation, maintenance and design of special circuits

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 11	Select and apply the use of rotary and linear actuators.	Understand
CO 12	Choose the different types of control and regulation elements.	Understand
CO 13	Design the various industrial circuits in hydraulic systems.	Remembering
CO 14	Retrieving the various pneumatic system and circuits.	Remembering
CO 15	Diagnose the faults and implement the maintenance measures	Apply

Course Contents

UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 9

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics

UNIT II CONTROL AND REGULATION ELEMENTS 9

Pressure - Direction and Flow control valves - Relief valves, non-return and safety valves – actuation systems.

UNIT III HYDRAULIC CIRCUITS 9

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits – press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels.

UNIT IV PNEUMATIC SYSTEMS AND CIRCUITS 9

Pneumatic fundamentals - control elements, pneumatic sensors - logic circuits – switches – fluidic logic circuits- Sequential circuits – Cascade methods – K-V Mapping methods - Step counter method – Classic methods**.**

UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS 9

Pneumatic equipment's- selection of components - design calculations – application -fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Total : 45 Periods

Text Books

1. Srinivasan R, "Hydraulic and Pneumatic Controls", Tata McGraw – Hill Education India, New Delhi, 2nd Edition, 2016
2. Anthony Esposito, "Fluid Power with Applications", Pearson Education Asia Delhi, New Delhi, 7th Edition, 2015.

Reference Books

1. Majumdar S.R., "Pneumatic Systems, Principles and Maintenance" Tata McGraw Hill, 2010
2. Bolton. W., "Pneumatic and Hydraulic Systems ", Butterworth –Heinemann, 1997
3. Andrew Parr, "Hydraulic and Pneumatics" (HB), Jaico Publishing House, 1999.
4. Dudley A. Pease and John J. Pippenger., "Basic fluid power", Prentice Hall, 1987

Additional References

3. **NPTEL** - https://nptel.ac.in/courses/112/105/112105046/
4. **MOOC Courses** - https://www.mooc-list.com/tags/pneumatics
5. https://ocw.mit.edu/courses/mechanical-engineering/2-000-how-and-why-machines-work-spring-

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 11	3	3	3	3	3							3	3	3
CO 12	3	3	3	3	3							3	3	3
CO 13	3	3	3	3	3							3	3	3
CO 14	3	3	3	3	3							3	3	3
CO 15	3	3	3	3	3							3	3	3
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	20	20	40
Understand	20	20	20	40
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20MEE05	DESIGN FOR MANUFACTURING AND ASSEMBLY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Manufacturing Technology 1&2				

Course Objectives

The course is intended to

1. Know the concept of design for manufacturing, assembly.
2. Know the computer application in design for manufacturing and assembly.
3. Discuss various fundamentals of assembly and design recommendations for product development
4. Understand how DFM&A impacts product cost and quality
5. Optimize tolerances to enhance manufacturability

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Outline the appropriate design for economical production and select the materials.	Remembering
CO 2	Select between various machining and metal joining processes.	Understand
CO 3	Apply a systematic understanding of knowledge in the field of metal casting and forging.	Applying
CO 4	Fabricate basic parts and assemblies using powered and non – powered machine shop equipment in conjunction with mechanical documentation.	Understand
CO 5	Integrate the knowledge of compliance analysis and interference analysis for assembly.	Applying

Course Contents

UNIT I INTRODUCTION **9**

Design philosophy – steps in design process – general design rules for manufacturability – basic principles of designing for economical production – creativity in design, application of linear &non-linear optimization techniques.
Materials: Selection of materials for design – developments in material technology – criteria for material selection – material selection interrelationship with process selection – process selection
charts.

UNIT II MACHINING PROCESS & METAL JOINING **9**

Machining process: Overview of various machining processes –general design rules for machining - dimensional tolerance and surface roughness – design for machining – ease – redesigning of components for machining ease with suitable examples, general design recommendations for machined parts.
Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines – pre and post treatment of welds – effects of thermal stresses in weld joints – design of brazed joints.

UNIT III METAL CASTING & FORGING **9**

Metal casting: Appraisal of various casting processes, selection of casting process, - general design considerations for casting – casting tolerances – use of solidification simulation in casting design –
product design rules for sand casting.
Forging: Design factors for forging – closed die forging design –parting lines of dies – drop forging die design – general design recommendations.

UNIT IV EXTRUSION AND SHEET METAL WORK **9**

Design guidelines for extruded sections - design principles for punching, blanking, bending, and deep drawing – Keeler Goodman forming line diagram – component design for blanking.

UNIT V ASSEMBLY **9**

Compliance analysis and interference analysis for the design of assembly – design and development of features for automatic assembly – Computer Applications for DFMA

Total : 45 Periods

Text Books

1. A K Chitale and R C Gupta, “Product Design and Manufacturing”, PHI, New Delhi, 2013.

Reference Books

1. George E Deiter, “Engineering Design”, Mc Graw Hill International, 2012.

2. Boothroyd G, “Product design for Manufacture and Assembly”, First Edition, Marcel Dekker Inc, New York, 1994.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	3	3		3							3	3	3
CO 2	3	3	3		3							3	3	3
CO 3	3	3	3		3							3	3	3
CO 4	3	3	3	3	3							3	3	3
CO 5	3	3	3	3	3							3	3	3
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20MEE06	OPTIMIZATION TECHNIQUES IN ENGINEERING DESIGN	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Numerical Methods				

Course Objectives

The course is intended to

1. Understand the various optimization parameters.
2. Classify the optimization techniques.
3. Use traditional optimization methods.
4. Demonstrate various modern optimization techniques.
5. Apply Optimization tools to solve practical problems.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Explain the various optimization parameters	Understand
CO 2	Summarize optimization techniques	Understand
CO 3	Experiment with traditional optimization methods	Applying
CO 4	Choose various modern optimization techniques.	Applying
CO 5	Solve the practical problems with optimization tools	Applying

Course Contents

UNIT I INTRODUCTION TO OPTIMIZATION 9

Introduction, Historical Development, Engineering Applications of Optimization, Design Vector, Statement of an Optimization Problem, Design Constraints, Constraint Surface, Objective Function, Objective Function Surfaces, Classification of Optimization Problems.

UNIT II CLASSICAL OPTIMIZATION TECHNIQUES 9

Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints, Multivariable Optimization with Inequality Constraints, Convex Programming Problem.

UNIT III TRADITIONAL OPTIMIZATION METHODS 9

Linear Programming, Definitions and Theorems, Simplex Algorithm, Duality in Linear Programming, Transportation Problem, Quadratic Programming, Random Search Methods, Steepest Descent (Cauchy) Method.

UNIT IV MODERN METHODS OF OPTIMIZATION 9

Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, Ant Colony Optimization, Optimization of Fuzzy Systems, Neural-Network-Based Optimization.

UNIT V PRACTICAL APPLICATION OF OPTIMIZATION 9

Reduction of Size of an Optimization Problem, Fast Reanalysis Techniques, Derivatives of Static Displacements and Stresses, Derivatives of Eigen values and Eigenvectors, Sensitivity of Optimum Solution to Problem Parameters.

Total : 45 Periods

Text Books

1. S S Rao, "Engineering Optimization: Theory and Practice ", Fourth Edition , John Wiley & Sons, 2009.
2. A. Ravindran, G. V. Reklaitis, K. M. Ragsdell, "Engineering Optimization: Methods And Applications", John Wiley & Sons, 2006

Reference Books

1. G. V. Reklaitis, Gintaras Victor Reklaitis, A. Ravindran, K. M. Ragsdell, Kenneth Martin Ragsdell, "Engineering Optimization: Methods and Applications", Wiley, 1983.
2. Kalyanmoy Deb, " Multi-Objective Optimization using Evolutionary Algorithms", John Wiley & Sons, 2001.
3. Kalyanmoy Deb, "Optimization for Engineering Design: Algorithms and Examples", PHI Learning Pvt. Ltd., 2012.

Additional References

1. **NPTEL** - https://nptel.ac.in/courses/105/108/105108127/
2. **MOOC Courses** - https://www.mooc-list.com/tags/optimization
3. ocw.mit.edu › electrical-engineering-and-computer-science › lecture-videos
4. www.edx.org › course › mathematical-optimization-for-engineers

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3	2	2	3							2	3	3
CO 2	3	3	2	2	3							2	3	3
CO 3	3	3	2	2	3							2	3	3
CO 4	3	3	2	2	3							2	3	3
CO 5	3	3	3	3	3							2	3	3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20MEE07	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Fluid mechanics and machinery				

Course Objectives

The course is intended to

1. Introduce various flow equations
2. familiarize numerical modelling and its role in flow problems
3. Understand various discretization methods in finite difference methods.
4. Solve finite volume method problems for convective and diffusion
5. Interpret the different types of ignition systems of the automotive

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Derive the governing equations and boundary conditions for Fluid dynamics	Understand
CO 2	Solve partial differential equations	Understand
CO 3	Analyze Finite difference method for Explicit and Implicit problems	Understand
CO 4	Analyze Finite volume method for Convective diffusion	Applying
CO 5	Explain the Turbulence models and Mesh generation techniques	Applying

Course Contents

UNIT I INTRODUCTION TO CFD **9**

Introduction to computational fluid mechanics, Application, merits, demerits, Continuity, Momentum, Energy equations, Boundary Conditions, Initial Conditions.

UNIT II MATHEMATICAL MODELLING **9**

Partial Differential Equations(PDEs) , Hyperbolic, Parabolic, Elliptic equations, Well-posed problems

UNIT III FINITE DIFFERENCE METHOD **9**

Introduction to Finite Differences, Differential equations, Explicit and Implicit approaches, Error, Stability analysis

UNIT IV FINITE VOLUME METHOD **9**

Introduction to finite volume method, 1D,2D,3D steady state diffusion with problems, 1D convection-diffusion problems, Various discretization schemes,

UNIT V GRID GENERATION AND TURBULENCE MODELLING 9

Grid generation techniques, structured, unstructured grids, staggerd and adaptive grids, SIMPLE,PISO Algorithms. Turbulence modelling Techniques , *k*–epsilon, *k*–omega, Reynolds stress equation model (RSM), SST (Shear Stress Transport)model.

Total : 45 Periods

Text Books

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd.Second Edition, 2007.
2. John David Anderson, "Computational Fluid Dynamics The Basics with Applications" McGraw-Hill, 2009.

Reference Books

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2012.
3. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 2017.

Additional References

1. **NPTEL** - https://nptel.ac.in/courses/112/105/112105045/
2. **MOOC Courses** - https://www.mooc-list.com/tags/fluid-dynamics
3. https://ocw.mit.edu/courses/mechanical-engineering/2-29-numerical-fluid-mechanics-spring-2015/
4. **Virtual laboratory –** http://users.metu.edu.tr/csert/virtualFlowLab/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	3	2	2	2							2	3	3
CO 2	3	3	2	2	2							2	3	3
CO 3	3	3	2	2	2							2	3	3
CO 4	3	3	2	2	2							2	3	3
CO 5	3	3	2	2	2							2	3	3
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20MEE08	ENGINEERING TRIBOLOGY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core (PE)				
Pre requisites	Kinematics of Machinery, Design of Machine Elements				

Course Objectives

1. To impart knowledge on theories of friction and wear
2. To acquire the concept of surface interaction and measurement.
3. To understand the properties of bearing material and lubricants.
4. To understand the analytical behaviour of hydrostatic and squeeze film lubrication
5. To learn the different types of hydrodynamic bearings and design of bearings based on analytical /theoretical approach

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Apply theories of friction and wear to various practical situations by analysing the physics of the process	Remembering
CO 2	Explain the various surface measurement techniques and effect of surface texture on tribological behaviour of a surface.	Understand
CO 3	Select materials and lubricants to suggest a tribological solution to particular situation	Understand
CO 4	Explain the hydrostatic and squeeze film lubrication	Understand
CO 5	Design a hydrodynamic bearing using various bearing charts	Applying

Course Contents

UNIT I FRICTION AND WEAR **9**

Friction, theories of friction, Wear, types of wear, theories of wear, genesis of friction, instabilities and stick-slip motion.

UNIT II SURFACE INTERACTION AND MEASUREMENT **9**

Friction control, Surface texture and measurement, wear prevention, Surface treatments, surface modifications, surface coating.

UNIT III LUBRICATION OF BEARINGS **9**

Tribological properties of bearing materials and lubricants. Reynolds's equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution), Finite Bearings.

UNIT IV HYDROSTATIC AND SQUEEZE FILM LUBRICATION **9**

Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings..

UNIT V ELASTO HYDRODYNAMIC LUBRICATION

9

Elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation, Hertz' theory, Ertel- Grubin equation, Design of hydrodynamic journal bearings lubrication of spheres, gear teeth and rolling element bearings, Air lubricated bearings, Tilting pad bearings.

Total : 45 Periods

Text Books

1. Majumdar, B C., "Introduction to Tribology of Bearings", S.Chand & Company Ltd.,New Delhi,2008.
2. Basu, S K., Sengupta, S N & Ahuja, B B., "Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd, New Delhi, 2005
3. Alastair, C. and Mc Ettles, C M., "Basic Lubrication Theory", Ellis Horwood, 1981

Reference Books

1. Stachowiak, G W. and Batchelor, A W., "Engineering Tribology", Butterworth- Heinemann, UK, 2005
2. Neale M.J (Editor), "The Tribology Handbook", Newnes. Butter worth Heinemann, U.K., 2016.
3. Stolarski, T A., "Tribology in Machine Design", Butterworth-Heinemann, UK, 2000.
4. Bharath Bhushan, "Introduction to Tribology", John Wiley & Sons, 2013.

Additional References

1. https://books.google.co.in/books?isbn=1420050478
2. s1.downloadmienphi.net/file/downloadfile9/195/1344905.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2		2								3	3	
CO 2	3	2		2								3	3	
CO 3	3	2		2								3	3	
CO 4	3	2		2								3	3	
CO 5	3	2		2								3	3	
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20MEE09	MECHANICAL VIBRATIONS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Understand the Fundamentals of Vibration and its practical applications
2. Understand the sources of vibration and noise in automobiles
3. Making design modifications to reduce the vibration and noise and improve the life of the components
4. Understand the working principle and operations of various vibrations measuring instruments
5. Understand the various Vibration control strategies

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Select particular method of vibration measurement based on the operating condition and environment	Understand
CO 2	Analyze the Single Degree, Two Degree freedom and Control the vibrations of equipment's used for various applications	Understand
CO 3	Analyze the Multi degree of Freedom Systems and continuous systems.	Apply
CO 4	Know the concepts of vibration control	Remembering
CO 5	Study the experimental methods in vibration analysis	Remembering

Course Contents

UNIT I FUNDAMENTALS OF VIBRATION 9

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration- Review of Single Degree Freedom Systems -Response to Arbitrary and non- harmonic Excitations – Transient Vibration

UNIT II TWO DEGREE FREEDOM SYSTEM 9

Introduction-Free Vibration of Un damped and Damped- Forced Vibration with Harmonic Excitation System –Coordinate Couplings and Principal Coordinates

UNIT III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM 9

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh, and Holzer Method - Geared Systems - Continuous System: Vibration of String, Shafts and Beams

UNIT IV VIBRATION CONTROL **9**

Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active Vibration Control

UNIT V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS **9**

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments -Selection of Sensors- Accelerometer Mountings. –Vibration Exciters-Mechanical, Hydraulic, Electromagnetic and Electrodynamics –Frequency Measuring Instruments-. System Identification from Frequency Response -Testing for resonance and mode shapes

Total : 45 Periods

Text Books

1. Mechanical Vibrations, Singiresu S. Rao, Prentice Hall; 5th Edition 2011
2. Rao.S.S, “Mechanical Vibrations”, 5th Edition, Pearson Education Inc. Delhi 2010

Reference Books

1. Rao, S.S., “Mechanical Vibrations”, 5th Edition, Addison Wesley Longman, New York, 2010
2. Thomson, W.T., “Theory of Vibration with Applications”, 5th Edition, Pearson, 2008
3. Rao, J.S. and Gupa, K., “Introductory Course on Theory and Practice Mechanical Vibration”, New Age International (P) Ltd., New Delhi, 1999.
4. Den Hartog, J.P. “Mechanical Vibrations”, Dover Publications, New York, 1990.

Additional References

1. **NPTEL** - https://nptel.ac.in/courses/112/103/112103111/
2. **MOOC Courses** - https://www.mooc-list.com/tags/vibrations
3. https://ocw.mit.edu/courses/mechanical-engineering/2-003sc-engineering-dynamics-fall-2011/mechanical-vibration/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 6	3	3	3	3	3							3	3	2
CO 7	3	3	3	3	3							3	3	2
CO 8	3	3	3	3	3							3	3	2
CO 9	3	3	3	3	3							3	3	2
CO 10	3	3	3	3	3							3	3	2
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

Passed in Board of Studies Meeting on 25.02.2022 *Passed in Academic Council Meeting on 09.03.2022*

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

20MEE10	DESIGN OF PRESSURE VESSELS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Educate the means of flow distribution and stress analysis in pressure vessels.
2. Student are able to understand the design consideration of pressure vessel.
3. Student are able to design the support of the pressure vessel
4. Student are able to design nozzle for pressure vessel
5. Student are able to design piping system for pressure vessel

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Relate the basics of Pressure vessel design.	Understand
CO 2	Familiarize with different types of stresses and their effects in pressure vessel.	Understand
CO 3	Equip with the Pressure vessel design	Understand
CO 4	Recognizing the failure in Pressure vessel.	Remembering
CO 5	Expose to the concept of piping layout and the stresses acting on it.	Remembering

Course Contents

UNIT I INTRODUCTION **9**

Methods for determining stresses – Terminology and Ligament Efficiency– Applications

UNIT II STRESSES IN PRESSURE VESSELS **9**

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components –Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF PRESSURE VESSELS **9**

Design of truss and supports for vertical vessels – stress concentration invariable Thickness sections such as cylindrical vessel, circular hole, and elliptical openings. Theory of Reinforcement – pressure vessel Design

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN PRESSURE VESSELS 9

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V PIPING 9

Introduction – Flow diagram – piping layout and piping stress analysis

Total : 45 Periods

Text Books

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers andDistributors,2001
2. Browenell L.E and Young E.D. "Process equipment design, Willey Esstern Ltd. India 2009

Reference Books

1. Smith P, “Fundamentals of Piping Design”, Elsevier.2007
2. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003American standard code for pressure piping , B 31.1
3. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Stanley, M. Wales, “Chemical process equipment, selection and Design”, Buter worths series in Chemical Engineering, 1988
5. Henry H. Bedner, “Pressure Vessels, Design Hand Book”, CBS publishers and Distributors, 1987

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	2	1	1	3	3							1	2	1
CO 2	2	1	1	3	3								2	1
CO 3	2	1	1	3	3								2	1
CO 4	2	1	1	3	3								2	1
CO 5	2	1	1	3	3								2	1
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

Passed in Board of Studies Meeting on 25.02.2022 *Passed in Academic Council Meeting on 09.03.2022*

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

Stream - II
Thermal Engineering

20MEE21	NON- CONVENTIONAL ENERGY SOURCES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Learn about solar radiation and solar thermal system application.
2. Provide knowledge on fundamentals and sizing of solar photo voltaics.
3. Study about the potential and energy conversion process of Wind Energy and Bio Energy.
4. Impart fundamental knowledge about Ocean Thermal Energy and Geothermal Energy.
5. Provide knowledge about the recent trends in Hydrogen and Fuel Cells.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Demonstrate knowledge of energy resources, energy conservation and solar energy fundamentals.	Understand
CO 2	Apply the solar energy principle in solar collectors and its applications.	Apply
CO 3	Explain the working concept of wind energy and bio energy conversion systems.	Understand
CO 4	Express the working of Geothermal and Ocean Energy conversion systems.	Remember
CO 5	Select the hydrogen and fuel cells energy field for various application	Apply

Course Contents

UNIT I ENERGY CONSERVATION AND SOLAR ENERGY 9

Energy sources and Conservation: Introduction, Conventional energy sources, Classification, Importance of renewable energy sources, energy alternatives, need and Principles of energy conservation. Fundamentals of Solar Energy: Site selection for solar plant, Solar constant and solar radiation geometry, Solar time and day length, Measurement of solar radiation - Pyranometer, Pyrheliometer and Sunshine recorder.

UNIT II SOLAR ENERGY COLLECTION DEVICES AND APPLICATION 9

Flat plate collector and types, Losses through flat plate collector Air collectors and types, Classification of concentrating collectors. Methods of storing solar energy - sensible heat storage, latent heat storage, Applications -Solar water heating, Solar Refrigeration, Solar thermal power generation, Solar distillation. Operating principle, Photovoltaic cell.

UNIT III WIND ENERGY AND BIOMASS ENERGY CONVERSION 9

Introduction, Site selection for wind energy plant, General formula - Betz limit - classification and working of horizontal axis wind turbine - vertical axis Wind turbines, Types of blades, Wind energy conversion systems, and environmental consideration. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels , Classification of biogas plants, Types of Digesters – Floating drum, fixed dome type biogas plants, comparison; variations of Biogas models – Pragati biogas model, Jwala biogas model, and Deenabandhu biogas model.

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UNIT IV GEOTHERMAL AND OCEAN ENERGY CONVERSION 9

Introduction, geothermal sources - Hydrothermal resources, geo pressurized resources, vapour dominated system, applications of geothermal energy, environmental consideration. Ocean thermal energy conversion, OTEC conversion technologies, Environmental impacts of OTEC; Tidal energy conversion - Principles of tidal and wave power generation, tidal energy conversion - single basin and double basin systems.

UNIT V HYDROGEN AND FUEL CELLS 9

Basic properties of hydrogen. Technologies of hydrogen production. Transformation of hydrogen energy - hydrogen economy. Fuel cells - operating principle, Alkaline Fuel cells (AFC), Phosphoric Acid Fuel cells (PAFC), Polymer Electrolyte Membrane Fuel cells (PEMFC), Specific characteristics, advantages and applications.

Total : 45 Periods

Textbooks:

1. G.D, Rai, Non-conventional Energy Sources, Khanna Publishers, 5th Editon, 2011.
2. B.H.Khan, Non-conventional Energy Sources, TMH, 3rd Edition, 2016.

Reference books:

1. S.P.Sukhatme and J.K Nayak, Solar Energy Principles of Thermal Collection and Storage, TMH, 3rd edition, 2008.
2. W.R.Murphy & G.Mckay, Energy Management, Butterworth, London, 2nd Edition, 2007.
3. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 2006

Additional References

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://swayam.gov.in/nd1_noc20_ge06

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	1					2						3	
CO 2	2	3					1						3	
CO 3	3	1					2						3	
CO 4	3	1					2						3	
CO 5	3	1					2						3	
	3-High				2-Medium				1-Low					

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	10	20	20
Understand	30	20	10	40
Apply		20	20	40
Analyse				
Evaluate				
Create				

20MEE22	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Thermal Engineering				

Course Objectives

The course is intended to

1. Provide the knowledge on various power plants and its sub systems.
2. Develop skills in finding the performance of a gas cooled reactor and all other power plants.
3. Explain advances in nuclear and MHD power plants.
4. Understand the environmental issues related to the power plants.
5. Explain economic analysis of power plants.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Demonstrate the knowledge on Steam power plants and its sub systems.	Understand
CO 2	Identify the various systems and components in diesel and gas power plants.	Understand
CO 3	Indicate the suitable components for nuclear power plants and hydel power plants	Understand
CO 4	Choose the components of power plants using thermodynamic analysis to predict the performance of the power plants.	Apply
CO 5	Find the capital cost and operating costs of a power plant and familiar about environmental pollution.	Understand

Course Contents

UNIT – I STEAM POWER PLANT **9**

Layout of Steam power plant - Components, Selection. Fuel and Ash Handling - Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, and Mechanical Collectors. Draught -different types. Cooling Towers.

UNIT – II DIESEL ENGINE AND GAS TURBINE POWER PLANTS **9**

Diesel Power Plant: Essential components of diesel power plant, Operation of diesel power plant, Plant layout with auxiliaries. Gas Turbine Plant: Requirements, Functions, Classification, Construction, and Layout with auxiliaries.

UNI – III HYDRO ELECTRIC AND NUCLEAR POWER PLANTS **9**

Hydro Electric Power Plant: Selection of site for power plant, Typical layouts, Elements of plant, Spill ways, Surge tank, Draft tube, Classification of Hydroelectric power plants, Hydrology. Nuclear Power Plants: Requirements, Functions, Nuclear fuel, Breeding and Fertile materials, Nuclear reactor, Reactor operation, Types Of Reactors - Pressurized water reactor, Boiling water reactor, Fast breeder reactor, Homogeneous reactor.

UNI – IV NON CONVENTIONAL POWER GENERATION AND DIRECT ENERGY CONVERSION SYSTEMS **9**

Non-Conventional Power Generation: Solar, Wind, Tidal, Ocean energy conversion, Geothermal, and biogas power plants. Direct energy conversion systems: Thermoelectric conversion system, Thermionic conversion system, Magneto Hydrodynamic systems and Fuel cells

UNIT– V POWER PLANT ECONOMICS AND POLLUTIONS **9**

Load curves, Load duration curve, Definitions of connected load, Maximum demand, Demand factor, Load factor, Plant capacity factor, Plant use factor, Diversity factor, Cost Analysis, Power plant pollution- Pollutions from Thermal and Nuclear Power plants.

Total : 45 Periods

Text books:

1. R.K.Rajput, A Text Book of Power Plant Engineering, Laxmi Publications, 3rd edition, 2014.
2. Arora and S. Domkundwar, A Course in Power Plant Engineering, Dhanpat Rai and Co, 3rd Edition, 2012.

Reference books:

1. P.K.Nag, Power Plant Engineering, TMH, 2nd edition, 2006.
2. K.K Ramalingam, Power plant Engineering, Scitech Publishers. 2nd edition, 2010.
3. Dr.P.C Sharma, power plant engineering, Sk Kataria and sons publishers, 8th Edition, 2011.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	1					2						3	
CO 2	3	1					2						3	
CO 3	3	1					2						3	
CO 4	2	3					1						3	
CO 5	2	3					1						3	
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – 1 (7.5)	**IAE – 2 (7.5)**	**IAE – 3 (10)**	
Remember	20	20	10	30
Understand	30	30	10	40
Apply			30	30
Analyze				
Evaluate				
Create				

20MEE23	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Provide the knowledge on air refrigeration systems
2. Know the refrigeration equipment and their application.
3. Impart the knowledge about Psychometrics and its applications
4. Realize the refrigeration equipment and their application.
5. Learn the parameters involved to select of air conditioning systems various applications

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Explain the components and working of vapour compression refrigeration systems	Understand
CO 2	Study the various refrigeration equipment's and its importance.	Understand
CO 3	Solve the psychometric problems in various applications	Apply
CO 4	Demonstrate knowledge of air conditioning and equipment with control systems	Understand
CO 5	Select the type of refrigeration and air conditioning for various applications.	Apply

Course Contents

UNIT I REFRIGERATION CYCLES AND REFRIGERANTS 9

Review of thermodynamics, Principle of refrigeration, Reversed Carnot cycle, Air refrigeration cycles - Bell Coleman cycle, Simple vapour compression refrigeration cycle, Vapour absorption system, Refrigerants – properties and classification, Alternate refrigerants, Selection of refrigerants.

UNIT II REFRIGERATION EQUIPMENT 9

Refrigeration compressors - Reciprocating, rotary and centrifugal compressors, Evaporators flooded, dry expansion, shell and tube and double pipe evaporators, Condensers – air cooled, water cooled and evaporative condensers, Expansion devices - capillary tube and thermostatic expansion valve.

UNIT III AIR CONDITIONING SYSTEM AND PSYCHROMETRIC 9

The principle of air conditioning and human comfort - factors affecting human comfort, classification of air conditioning systems - Summer, winter and year-round air conditioning, working principle of window, split and central air conditioning, Psychrometric - properties, processes and use of Psychrometric charts.

UNIT IV AIR CONDITIONING EQUIPMENT 9

Air distribution and ventilation system, Equipment - chillers, air handling unit, air washers, filters types, Room dehumidifiers, desert coolers cooling and heating coils, Cooling tower -natural and mechanical draught system, Control system - pneumatic and electric system for air conditioning.

UNIT V APPLICATIONS OF REFRIGERATION AND AIR CONDITIONING SYSTEMS 9

Preservation of different products - Food preservation , ice factory , domestic refrigerator, Applications of air conditioning - Commercial applications - Air conditioning of houses and offices, air conditioning of hospitals - Industrial applications - Refrigeration for liquefied natural gas - Transport Air-conditioning - Railway Air conditioning , Aircraft air conditioning.

Total : 45 Periods

Text books:

1. C.P. Arora, "Refrigeration and Air Conditioning", The Mc Graw Hill Education, 3rd edition, New Delhi, 2008.
2. S.C. Arora and Domkundwar S., “Refrigeration and Air conditioning”, 7th edition Dhanpat Rai & Sons, New Delhi, 2006.

Reference books:

1. Roy J. Dossat, "Principles of Refrigeration", 4th Edition, Pearson India, 2007.
2. Manohar Prasad, "Refrigeration and Air Conditioning", 3rd Edition, New Age International, New Delhi, 2015.
3. R. S. Khurmi, J. K. Gupta,"Textbook of Refrigeration And Air Conditioning”, Revised edition, S. Chand, 2015.
4. S.S. Thipse, Refrigeration and Air Conditioning, 1st Edition, Jaico Publishing House, 2007.

Additional References

1. https://onlinecourses.nptel.ac.in/noc21_me85/preview
2. https://nptel.ac.in/courses/112/107/112107208

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2					1						3	
CO 2	3	2					1						3	
CO 3	2	3	1										3	
CO 4	3	2					1						3	
CO 5	2	3					1						3	
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	10	10	20
Understand	30	20	20	40
Apply		20	20	40
Analyse				
Evaluate				
Create				

20MEE24	TURBO MACHINES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Understand the basic types of Turbo Machines.
2. Understand the Working Principles of Reaction Turbines.
3. Gain some basic Concept of Reaction Turbines.
4. Know Classification and Principles of Hydraulic Turbines.
5. Learn analyze skill for Centrifugal Pumps performance.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Understand the fundamental concepts of turbo machines	Understand
CO 2	Apply Euler's equation for turbo machinery to analyse energy transfer in Parsons's turbines.	Apply
CO 3	Understand the thermodynamic analysis of steam turbine and its types.	Understand
CO 4	Evaluate the performance parameters of **Hydraulic** turbines by using velocity triangles.	Analyze
CO 5	Familiarize the basic concepts of pumps and analyze the performance of **Centrifugal Pumps.**	Analyze

Course Contents

UNIT I INTRODUCTION 9

Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification.

UNIT II REACTION TURBINE 9

Parsons's turbine, condition for maximum utilization factor, reaction staging.

UNIT III STEAM TURBINES 9

Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor.

UNIT IV HYDRAULIC TURBINES 9

Classification, various efficiencies. Pelton Wheel – Principle of working, velocity triangles, design parameters, maximum efficiency.

UNIT V CENTRIFUGAL PUMPS 9

Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Theoretical head – capacity relationship, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel.

Total : 45 Periods

Text Books

1. An Introduction to Energy Conversion, Volume III, Turbo machinery V. Kadambi and Manohar Prasad New Age International Publishers reprint 2008.
2. Turbo machines M. S. Govinde gowda and A. M. Nagaraj M. M. Publications 7th Ed, 2012.

Reference Books

1. S. M. Yahya ,Turbines, Compressors & Fans Tata McGraw Hill Co. Ltd 2nd edition, 2002.
2. D. G. Shepherd, Principals of Turbo machines, The Macmillan Company 2001.
3. S. L. Dixon, Fluid Mechanics & Thermodynamics of Turbo machines, Elsevier 2005.

Additional References

1. Nptel - https://nptel.ac.in/courses/112/106/112106303/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2	1										3	
CO 2	2	3	1										3	
CO 3	3	2	1										3	
CO 4	1	3	2										3	
CO 5	2	3	1										3	
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	10	10	20
Understand	30	20	10	30
Apply		20		20
Analyse			30	30
Evaluate				
Create				

20MEE25	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

Nature of Course	Professional Elective (PE)
Pre requisites	Thermodynamics, Fluid Mechanics.

Course Objectives

The course is intended to

1. Construct the basic Concepts of incompressible and compressible flow.
2. Learn the phenomenon of Flows through constant area ducts with heat transfer.
3. Study the flow parameters across the normal and oblique shocks.
4. Illustrate some basic knowledge about jet propulsion.
5. Explain Applications of Rocket Propulsions.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Understand the concept of continuity, momentum and energy equations to compressible flows	Understand
CO 2	Apply the Rayleigh and Fanno flow correlations for the compressible flow with a heat transfer condition.	Apply
CO 3	Solve problems involving isentropic and non-isentropic flows including flows across normal and oblique shock waves.	Apply
CO 4	Discuss the mechanism of jet propulsion and engines of aircrafts and rockets.	Understand
CO 5	Analyze different types of rocket propulsion systems.	Analyse

Course Contents

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers

UNIT II FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalised gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT IV JET PROPULSION 9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V SPACE PROPULSION **9**

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

Note: Use of Standard Gas Tables permitted

Total : 45 Periods

Text Books

1. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2004.
2. H. Cohen, G.E.C. Rogers and Saravanamutto, Gas Turbine Theory, Longman Group Ltd., 2001.

Reference Books

1. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York,2000,.
2. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
3. Radhakrishnan E. – 'Gas Dynamics' – Prentice-Hall of India Pvt. Ltd – 2004

Additional References

1. NPTEL - https://nptel.ac.in/courses/112/106/112106166/
2. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	1										3	
CO 2	2	3	1										3	
CO 3	2	3	1										3	
CO 4	3	2					1						3	
CO 5	2	3					1						3	
	3-High				2-Medium				1-Low					

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	10	10	10
Understand	30	10		30
Apply		30	20	40
Analyse			20	20
Evaluate				
Create				

20MEE26	INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Thermal Engineering				

Course Objectives

The course is intended to

1. Learn about the combustion phenomenon in spark ignition engines.
2. Learn about the combustion phenomenon in compression ignition engines.
3. Study the causes, effects and control of pollutants from an Internal Combustion engine.
4. Provide the knowledge of alternate fuels in Internal Combustion engines.
5. Impart the knowledge on recent developments in Internal Combustion engines.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Interpret the combustion phenomenon in spark ignition engines.	Understand
CO 2	Explain the combustion phenomenon in compression ignition engines	Understand
CO 3	Show the formation of emission and various methods to reduce emissions.	Remember
CO 4	Identify the uses of alternate fuels in Internal Combustion engines.	Apply
CO 5	Show the recent developments in Internal Combustion engines.	Understand

Course Contents

UNIT I INTRODUCTION TO SPARK IGNITION ENGINES 9

Spark Ignition Engines Spark ignition engine- Mixture requirements - Feedback control - Carburetors-Fuel injection systems Mono point and Multipoint injection -Stages of combustion - Normal and Abnormal combustion Factors affecting knock-Combustion chambers.

UNIT II CI ENGINES AND TURBO CHARGING 9

Compression Ignition Engines States of combustion in C.I. Engine –Combustion knock in CI engines – Knock comparison in SI and CI Engines-Methods of controlling knock- Direct and indirect injection systems - Combustion chambers - Fuel spray behavior- spray structure, spray penetration, Turbo charging. Physical factors affecting ignition delay.

UNIT III EMISSION CONTROL 9

Pollutant Formation and Control Pollutant - Sources and types - formation of NOx - Hydrocarbon emission mechanism - Carbon monoxide formation - Particulate emissions – Measurement of exhaust emissions-Methods of controlling emissions- Catalytic converters.

UNIT IV ALTERNATIVE FUELS 9

Alternative Fuels Bio-fuels: Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas – Properties – Suitability - Engine Modifications - Merits and Demerits as fuels. Biodiesel production process.

UNIT V RECENT TRENDS IN IC ENGINES **9**

Recent Trends Lean Burn Engines - Stratified Charge Engines – Gasoline: Direct Injection Engine – Common rail Diesel injection system (CDRI)- Homogeneous charge compression ignition - Plasma Ignition – Ignition Measurement techniques.

Total : 45 Periods

Text Books

1. Ganesan V., Internal Combustion Engines, Tata McGraw Hill Publishing Company PvtLtd., New Delhi, 2007.
2. John B. Heywood, Internal Combustion Engine Fundamentals, Tata McGraw Hill Publishing Company Private limited., New Delhi, 2015.

Reference Books

1. H. N. Gupta Fundamentals of Internal Combustion Engineering, Prentice Hall of India Pvt Ltd, New Delhi, 2006.
2. R. B. Mathur and R. P. Sharmal Internal Combustion Engines, Dhanpat Rai Publications, 2008.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2					1						3	
CO 2	3	2					1						3	
CO 3	3	2					1						3	
CO 4	2	3					1						3	
CO 5	3	2					1						3	
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	20	10	20
Understand	30	30	20	60
Apply			20	20
Analyse				
Evaluate				
Create				

20MEE27	CRYOGENIC ENGINEERING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Thermodynamics, and Heat Transfer				

Course Objectives

The course is intended to

1. To understand the basic concepts of cryogenic systems
2. To gain the knowledge of air-liquefaction processes to practical situations.
3. To Interpret and analyze the separation of cryogenic gases techniques.
4. To understand the classification of Cryogenic refrigeration systems
5. To understand the various measuring flow techniques in cryogenic engineering

Course Outcomes

On successful completion of this course the student will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Illustrate the concepts of cryogenic systems.	Understand
CO2	Relate air-liquefaction processes to practical situations.	Remember
CO3	Interpret and analyze the separation of cryogenic gases techniques.	Apply
CO4	Classify Cryogenic refrigeration systems.	Remember
CO5	Apply the various measuring flow techniques in cryogenic engineering	Apply

Course contents:

UNIT I INTRODUCTION TO CRYOGENICS 9

Insight on cryogenics - properties of cryogenic fluids - material properties at cryogenic temperatures - Applications of cryogenics in space programs, superconductivity, cryo metallurgy, biological and medical applications.

UNIT II REFRIGERATION AND LIQUEFACTION 9

Simple Linde cycle, Pre-cooled Joule-Thomson cycle, dual pressure cycle, Simon helium liquefier, classical cascade cycle, mixed-refrigerant cascade cycle.

UNIT III SEPARATION AND PURIFICATION SYSTEMS 9

Basics of Gas separation - Ideal separation of gases, characteristics of mixtures and the governing laws - T-C and H-C diagrams. Principle of Rectification - Rectification column - Theoretical plate calculations using McCabe-Thiele method, Gas purification.

UNIT IV STORAGE AND HANDLING OF CRYOGENIC REFRIGERANTS 9

Storage and Transfer systems, Insulation, Various Types of Insulation typically employed, Poly Urethane Foams (PUFs) and Polystyrene Foams (PSFs), Vacuum Insulation, and so on.

UNIT V STORAGE AND INSTRUMENTATION 9

Cryogenic Dewar vessels construction and design, cryogenic transfer Lines. Cryogenic insulation - vacuum, powder, multi layer, micro-sphere and foam-fibrous insulation - concept of vapour coated shields. Cryogenic instrumentation - temperature, flow and level measurements.

Total : 45 Periods

Text Books

1. Traugott H.K. Frederking and S.W.K. Yuan, Cryogenics - Low Temperature Engineering and Applied Sciences, Yutopian Enterprises, 2005.
2. Arora, C.P., Refrigeration and Air-conditioning, Tata-McGraw Hill, 2008.

References

1. Robert W. Vance, Cryogenic Technology, John wiley & Sons, Inc., New York, London.
2. A. R. Jha, Cryogenic Technology and Applications, Butterworth-Heinemann, 2005.
3. G.Venkatarathnam, Cryogenic Mixed Refrigerant Processes, Springer Publication, 2010.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2					1						3	
CO 2	3	2					1						3	
CO 3	2	3					1						3	
CO 4	3	2					1						3	
CO 5	2	3					1						3	
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	10	10	20
Understand	30	20	20	40
Apply		20	20	40
Analyse				
Evaluate				
Create				

20MEE28	DESIGN OF HEAT EXCHANGERS	L	T	P	C
		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Courses on Heat Transfer.				

Course Objectives

The course is intended to

1. Complete knowledge of heat exchanger and its applications
2. Design and analyze the heat exchangers parallel flow, counter flow, multi pass and, cross flow heat exchanger
3. Design and analyze the Shell and tube heat exchanger
4. Enable to carry out the performance of heat exchanger
5. Design and analyze the cooling towers, condensers and evaporators

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Understand the physics and the mathematical treatment of typical heat exchangers and types.	Understand
CO 2	Employ LMTD and Effectiveness methods in the design of heat exchangers and analyze the importance of LMTD approach over AMTD approach	Apply
CO 3	Analyze the performance of double-pipe and Shell & Tube heat exchangers.	Analyze
CO 4	Design the cooling towers, condenser, and evaporators along with explain their technical features.	Analyze
CO 5	Select and design of vaporizers and heat pipes for various application	Apply

Course Contents

Unit – I CLASSIFICATION OF HEAT EXCHANGERS 9

Introduction, Recuperation & regeneration, Tabular heat exchangers, Double pipe, shell & tube heat exchanger, Plate heat Exchangers, Gasketed plate heat exchanger. Spiral plate heat exchanger. Introduction, Basic equations in design, Overall heat transfer coefficient, LMTD method for heat exchanger analysis, Parallel flow, Counter-flow. Multi-pass, cross flow heat exchanger design calculations.

Unit – II DOUBLE PIPE AND SHELL & TUBE HEAT EXCHANGERS 9

Double Pipe Heat Exchanger: Film coefficient for fluids in annulus, fouling factors, calorific temperature, Average fluid temperature, The calculation of double pipe exchanger, Double pipe exchangers in series parallel arrangements. Shell & Tube Heat Exchangers: Tube layouts for exchangers. Calculation of shell and tube heat exchangers, Shell side film coefficients, Shell side equivalent diameter.

Unit – III CONDENSER AND EVAPORATORS 9

Condenser: Types of condenser, Estimation of heat transfer coefficient, Fouling factor, Friction factor-Design procedures, Wilson plots, Design of different types of condensers. Evaporator: Different types of evaporators, Design procedure, Factors affecting the evaporator capacity, Design of evaporative condensers.

Unit – IV COOLING TOWERS AND VAPORIZERS 9

Cooling towers: The Lewis number and Classification of cooling towers, Cooling tower internals and the roll of fill, Deign of cooling towers, Determination of the number of diffusion units, Calculation of cooling tower performance. Vaporizer: Vaporizing processes, Forced circulation vaporizing exchanger, Natural circulation vaporizing exchangers.

Unit – V HEAT PIPE 9

Heat pipe: types and applications, operating principles, working fluids, wick structures, control techniques, pressure balance, maximum capillary pressure, liquid and vapor pressure drops, effective thermal conductivity of wick structures, determination of operating conditions.
Heat pipe design – fluid selection, wick selection, material selection, preliminary design considerations, heat pipe design procedure, determination of heat pipe diameter, wick design, design problems

Total : 45 Periods

Text Books

1. A.P.Fraas and M.N.Ozisick ,Heat Exchanger Design, John Wiely & sons, New York.2003.
2. Kakac, S., A.E. Bergles and F. Mayinger , Heat Exchangers: Selection, Rating, and Thermal Design, Second Edition - Hemisphere, 2001.

Reference Books

1. James R. Couper; W. Roy Penney, James R. Fair, Stanley M. Walas, Chemical Process Equipment: selection and design, Elsevier Inc., 2nd ed.2005.
2. Nicholas Cheremisioff , Cooling tower , Ann Arbor Science pub. 2000.
3. Heat Pipes Dunn, P. D. and Reay, D. A., , Fourth Edition, Pergamon Press, 1994.

Additional / Web References

1. Standards of the Tubular Exchange Manufacturers Association, TMEA, New York.
2. Kern K.H., Process heat transfer, McGraw-Hill, 2002.
3. https://nptel.ac.in/courses/112/105/112105248/
4. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-me43/
5. https://nptel.ac.in/courses/103/103/103103027/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1										3	
CO2	3	2	1										3	
CO3	2	3	1										3	
CO4	1	3	2										3	
CO5		3				1	2						3	
	3	High				2	Medium					1	Low	

Formative Assessment			
blooms taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – 1 (7.5)	**IAE – 2 (7.5)**	**IAE – 3 (10)**	
Remember	20	10	10	20
Understand	30			20
Apply		20	20	30
Analyze		20	20	30
Evaluate				
Create				

20MEE29	COGENERATION AND WASTE HEAT RECOVERY SYSTEMS	L	T	P	C
		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Thermal Engineering				

Course Objectives

The course is intended to

1. Gain fundamental knowledge in energy generation, heat transfer in thermal engineering
2. Analyze the basic energy generation cycles
3. Detail about the concept of cogeneration its types and probable areas of applications
4. Study the significance of waste heat recovery systems and carry out its economic analysis.
5. Reduce the impact global warming for betterment of living things to serve healthy life

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcomes	Bloom's Level
CO 1	Demonstrate the knowledge in energy generation and cogeneration technologies	Understand
CO 2	Apply the energy generation principle and for various application	Apply
CO 3	Understands the significance of waste heat recovery systems	Understand
CO 4	Apply the concept of waste heat recovery for probable areas of applications,	Apply
CO 5	Explain the economics in cogeneration, waste heat recovery systems and reduce the impact global warming	Understand

Course Contents

UNIT – I COGENERATION AND TECHNOLOGIES 9

Introduction - Principles of Thermodynamics - Combined Cycles - Topping - Bottoming - Organic Rankine Cycles. Advantages of Cogeneration Technology- Steam turbine cogenerations systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems.

UNIT – II COGENERATION APPLICATION 9

Cogeneration Application in various Industries like Cement, Sugar Mill, Paper Mill etc. Sizing of Waste Heat Boilers - Performance Calculations - Part Load Characteristics, Selection of Cogeneration Technologies.

UNIT– III WASTE HEAT RECOVERY **9**

Introduction - Principles of Thermodynamics and Second Law - Sources of Waste Heat Recovery -
Systems-recuperators – Regenerators – economizers –thermic fluid heaters – Waste heat boilers – classification, location, service conditions, design Considerations, Heat pumps.

UNI – IV WASTE HEAT RECOVERY APPLICATIONS **9**

Applications in Industries - Fluidized Bed Heat Exchangers - Heat Pipe Exchangers - Heat Pumps - Thermic Fluid Heaters Selection of Waste Heat Recovery Technologies, Selection criteria for waste heat recovery technologies.

UNI – V ECONOMIC ANALYSIS **9**

Economic Analysis- Investment cost - economic concept - measure of economic performance – procedure for economic analysis – examples – Procedure for optimized system selection and design load curves – sensitivity analysis – regulatory and financial frame work for cogeneration and waste heat recovery systems.

Total : 45 Periods

Text Books:

1. Hussam Jouhara, Waste Heat Recovery in Process Industries, Wiley-VCH; 1st edition, 2021.
2. Sengupta Subrata, Lee SS EDS, Waste Heat Utilization and Management, Hemisphere, Washington, 2002.

Reference Books:

1. De Nevers, Noel, Air Pollution Control Engineering, McGraw Hill, New York, 1995.
2. Energy Cogeneration Hand book, George Polimveros, Industrial Press Inc, New yark 2003.
3. Horlock JH., Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford,1987.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	1										3	
CO 2	2	3					1						3	
CO 3	3	2					1						3	
CO 4	3	1					2						3	
CO 5		3				1	2						3	
	3	High				2	Medium					1	Low	

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – 1 (7.5)	**IAE – 2 (7.5)**	**IAE – 3 (10)**	
Remember	20	10	10	30
Understand	30	20	20	40
Apply		20	20	30
Analyze				
Evaluate				
Create				

20MEE30	GAS TURBINES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Understand the basic principles of Aircraft Applications
2. Carry out the Compressors Performance
3. Gain some basic knowledge about jet propulsion and Rocket Propulsions
4. Know about Cooling Systems and Air Pollution
5. Understand Power plant Components with Applications

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Illustrate to learn aircraft applications of power plant cycles	Understand
CO 2	Summarize the compressors momentum and energy transfer in rotors	Understand
CO 3	Calculate the performance Characteristics of axial and radial flow turbines.	Apply
CO 4	Identify the combustors types and air pollution reduction	Apply
CO 5	Explain matching procedure of power plant components	Understand

Course Contents

UNIT I INTRODUCTION TO GAS TURBINES 9

Power plant cycles for stationary and aircraft applications, component behaviors, Industrial applications, Marine and land transportation, Environmental issues, analysis of ramjet, turbojet and turbo-propeller, Inlets and nozzles.

UNIT II COMPRESSORS 9

Principle and operations of Centrifugal and axial flow compressors momentum and energy transfer in rotors, velocity diagrams, calculation of stage performance, compressibility effects, cascade testing and characteristics.

UNIT III AXIAL AND RADIAL FLOW TURBINE 9

Elementary theory of axial and radial flow turbine, Vortex theorem, choice of blade profile, Pitch and Chord Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, materials, testing and performance characteristics.

UNIT IV COMBUSTORS 9

Different types and flow pattern, material requirement and cooling systems, air pollution and reduction.

UNIT V MATCHING 9

Matching procedure of power plant components, engine off-design performance.

Total : 45 Periods

Text Books

1. L.Cohen, H., Rogers, G.E.C., and Saravana muttoo, H.I.H., Gas Turbine Theory, Longman Group Ltd, 2009.
2. Yahya, S.H., Turbines, Compressors and Fans, Tata McGraw-Hill,4th edition 2013.

Reference Books

1. Earl Logan, Jr., Hand book of Turbo machinery, Marcel Dekker, Inc., USA, 2 nd edition 2003.
2. Dixon,S.L., Fluid Mechanics and Thermodynamics of Turbo machinery,Pergamon Press,7th edition 2014

Additional References

1. Meherwan p. Boyce ,Gas turbine engineering hand book,(2nd edition)
2. Nptel - https://nptel.ac.in/courses/112/103/112103262/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	1										3	
CO 2	2	3	1										3	
CO 3	2	3	1										3	
CO 4	3	2	1										3	
CO 5	3	2	1										3	
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	10	10	20
Understand	30	20	20	40
Apply		20	20	40
Analyse				
Evaluate				
Create				

Stream - III

Manufacturing Engineering

20MEE41	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Understand the concept of liquid, solid and powder based rapid prototyping techniques for rapid product development
2. Study the basic principle of Additive manufacturing processes.
3. Examine the extrusion and sheet lamination based of engineering process and its applications of AM
4. Understand the basic procedure of polyhedral B-rep modeling processes.
5. Know the principle, methods, possibilities and limitations as well as environmental effects of Additive Tooling Processes.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Apply the concept of liquid, solid and powder based rapid prototyping techniques for rapid product development.	Apply
CO 2	Explain the basic Principle of AM technologies and their classification of additive manufacturing Processes.	Understand
CO 3	Classify the extrusion and sheet lamination based of engineering process and its applications of AM	Understand
CO 4	Illustrate the procedure of polyhedral B-Rep modeling and processing of STL files.	Understand
CO 5	Execute the rapid tooling and software for rapid manufacturing to meet international needs.	Understand

Course Contents

UNIT I INTRODUCTION **9**

Rapid Product Development (RPD) –Product Development Cycle – Detail design– Prototype and tooling.

UNIT II ADDITIVE MANUFACTURING (AM) **9**

Principle of AM technologies and their classification of AM systems–Stereo lithography systems – Selection of AM process; Issues in AM ; Emerging trends–Direct Metal Laser Sintering (DMLS) system – Principle – process parameters – process details – Applications.

UNIT III ENGINEERING PROCESS **9**

Fusion Deposition Modeling –Laminated Object Manufacturing –Selective Laser Sintering- Three dimensional Printing-Reverse Engineering -Engineering applications–Medical applications.

UNIT IV PROCESSING POLYHEDRAL DATA 9

Polyhedral B-Rep modeling–STL format– Defects and repair of STL files– Processing STL files; Overview of the algorithms required for RPANDT- slicing, support generation, feature recognition

UNIT V ADDITIVE TOOLING (AT) 9

Introduction to AT–Indirect AT processes – Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting; Direct AT processes – Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting); Emerging Trends in AT

Total : 45 Periods

Text Books

1. Ian Gibson, David W. Rosen, Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" Springer, 2017
2. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2015.

Reference Books

1. C K Chua, K F Leong, C S Lim, Rapid Prototyping Principles and Applications, World Scientific, New Delhi, 2015.
2. Frank W.Liou, Rapid Prototyping and Engineering Applications, CRC Press, UK, 2017.
3. Terry wohlers, Wohlers Report 2000, Wohlers Associates, USA, 2015.
4. Pham, D.T. and Dimov . S.S., "Rapid Manufacturing", Springer-Verlag, London, 2017.

Additional References

1. http:www.learnerstv.com/free-engineering-video-lectures- ltv234-page1.htm
2. http:www.learnerstv.com/free-engineering-video-lectures- ltv530-page1.htm
3. NPTEL – https://nptel.ac.in/courses/112/103/112103306/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
Cos	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2			3							2		3
CO 2	3	2			3							2		3
CO 3	3	2			3							2		3
CO 4	3	2			3							2		3
CO 5	3	2			3							2		3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20MEE42	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Understand the Fundamental concepts in manufacturing and automation
2. Identify the performance of assembly systems
3. Explain the automated material handling and features
4. Understand the basic structure of PLC
5. Describe the data acquisitions system

Course Outcome

After the successful completion of this course, the student will be able to:

CO. No	Course Outcome	Bloom's Level
CO 1	Identify the various types and levels of automation strategy	Understand
CO 2	Describe the Automated Assemble parts	Understand
CO 3	Construct a program using PLC to problems pertaining to automation industries.	Understand
CO 4	To introduce the PLC for Automation	Understand
CO 5	Explain the applications of SCADA	Understand

Course Contents

UNIT I MANUFACTURING AND AUTOMATION **9**

Fundamental concepts in manufacturing and automation - Types and Levels of automation - automation strategies - automation migration strategy - Introduction to CIM - components of CIM - process design for CIM - Automated flow lines - methods of work transport - automated flow lines with and without storage buffers.

UNIT II AUTOMATED ASSEMBLY **9**

Parts feeding devices - single and multi-station assembly machines - Performance and Economics of assembly systems - Feasibility study for assembly automation.

UNIT III AUTOMATED MATERIAL HANDLING AND INSPECTION **9**

Automated guided vehicle system - components of AGVS - control system - routing - design features - AS/RS components - design of an AS/RS - Automated Inspection.

UNIT IV INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLERS **9**

Definitions of PLC, basic structure of PLC, working principles, data storage methods, inputs / outputs flag processing's, types of variables, definition of firmware, software, programming software tool and interfacing with PC (RS232 & TCP-IP), methods of PLC programming (LD, ST, FBD & SFC),

UNIT V MODULE SUPERVISORY CONTROL & DATA ACQUISITIONS **9**

Introduction to Supervisory control & data Acquisitions, distributed Control System (DCS): computer networks and communication in DCS. different BUS configurations used for industrial automation – GPIB, HART and OLE protocol, Industrial field bus –FIP (Factory Instrumentation Protocol),

PROFIBUS (Process field bus), Bit bus. Interfacing of SCADA with controllers, Basic programming of SCADA, SCADA in PC based Controller / HMI

Total : 45 Periods

Text Books

1. Mikell P Groover, "Automation, Production Systems and Computer - Integrated Manufacturing", Pearson India Education Services, 2016.
2. Programmable Logic Controllers by W.Bolton

References Books

1. Roger Hannam, "Computer Integrated Manufacturing: From Concepts to Realisation", Prentice Hall, 1997.
2. Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley and Sons, New York, 1996.
3. Introduction to Programmable Logic Controllers by Garry Dunning, 2ndedition, Thomson, ISBN:981-240-625-5

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3				3			3						
CO 2	3				3			3						
CO 3	3				3			3						
CO 4	3				3			3						
CO 5	3				3			3						
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20MEE43	MODERN MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Unconventional Machining Process				

Course Objectives

The course is intended to

1. Understand the classification of Various modern manufacturing processes
2. Study the different Mechanical Machining Processes
3. Familiarize the students In the field of Thermoelectric Machining Processes
4. Make the students to learn the various Electrochemical and Chemical Manufacturing Processes
5. Able the students to Understand the Micro Electro Mechanical Systems(MEMS) and Nanotechnology

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Recall the classification of Various modern manufacturing processes	Remembering
CO 2	Explain the Mechanical Machining Processes	Understand
CO 3	Classify the Thermoelectric Machining Processes	Understand
CO 4	Illustrate the various Electrochemical and Chemical Manufacturing Processes	Understand
CO 5	Outline the Micro Electro Mechanical Systems and Nanotechnology.	Understand

Course Contents

UNIT I INTRODUCTION 9

Need for modern manufacturing methods-Classification of Various modern manufacturing processes– Their selection for processing of different materials and the range of applications.

UNIT II MECHANICAL MACHINING PROCESSES 9

Abrasive Jet Machining (AJM) - Abrasive Finishing Processes – Magnetic Abrasive Finishing (MAF) - Water Jet Machining (WJM) - Abrasive Water Jet Machining (AWJM) - Process principle, Process equipment, Process Parameters, Process Capabilities, Applications, Limitations.

UNIT III THERMOELECTRIC MACHINING PROCESSES 9

Electric Discharge Machining (EDM), Electric Discharge Grinding , Wire Electric Discharge Machining, Laser Beam Machining (LBM), Plasma Arc Machining, (PAM), Electron Beam Machining(EBM) - Process principle, Process equipment, Process Parameters; Process Capabilities; Applications; Limitations.

UNIT IV ELECTROCHEMICAL AND CHEMICAL MANUFACTURING PROCESSES **9**

Fundamentals of Electrochemical Machining (ECM), Electromechanical Grinding (ECG) - Metal Removal rate in ECM, tooling, process variable applications, economic aspects of ECM. Fundamentals of Chemical Machining (CHM) - Principle of material removal-mask ants – etchants - process variables, advantages and applications.

UNIT V MEMS AND NANOTECHNOLOGY **9**

MEMS (Micro Electro Mechanical Systems) - Development and need of MEMS, overview of MEMS Technology with relevant non-conventional processes. Nano materials, Nano tubes and Nano wires, Nanofabrication.

Total : 45 Periods

Text Books

1. V.K.Jain – Advanced Machining Processes, Allied Publishers Pvt. Limited, India 2017
2. P.K.Misra - Non-conventional Machining, Narosa Publishers,2018
3. MikellP.Groover – Fundamental of Modern Manufacturing: Materials, Processes and Systems,2016
4. Pandey & Shan - Modern Machining Processes, Tata McGraw Hill 2015

Reference Books

1. Manufacturing processes for engineering materials by seropekalpakjian and Steven R schmid 2018
2. Manufacturing Technology, Kalpakzian, person 2016
3. New technology, Bhattacharya, the institution of engineers, India 2015

Additional References

1. http:www.learnerstv.com/free-engineering-video-lectures- ltv234-page1.htm
2. http:www.learnerstv.com/free-engineering-video-lectures- ltv530-page1.htm
3. NPTEL –https://nptel.ac.in/courses/112/107/112107078/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2			3							2		3
CO 2	3	2			3							2		3
CO 3	3	2			3							2		3
CO 4	3	2			3							2		3
CO 5	3	2			3							2		3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20MEE44	INDUSTRIAL ROBOTICS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Manufacturing Process				

Course Objectives

The course is intended to

1. Introduce the basic concepts, parts of robots and types of robots.
2. Study the use of various types of robot drive systems and End Effectors
3. Study the robotic control using the principle behind sensors and machine vision systems.
4. Impart knowledge in Robot Kinematics and Programming
5. Discuss about the various applications of robots, justification and implementation of robot economics

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Classify the various robot configuration and components	Understand
CO 2	Explain the various types of drive systems and end effectors	Understand
CO 3	Select appropriate sensors and end effectors for a robot based on specific application	Remembering
CO 4	Execute the concepts of robot kinematics and robot programming	Understand
CO 5	List the various applications of robots, implementation and economics	Remembering

Course Contents

UNIT I FUNDAMENTALS OF ROBOT 9

Robot - Definition - Robot Anatomy - Co-ordinate Systems, Work Envelope Types and Classification-Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion. Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III ROBOT SENSORS AND MACHINE VISION 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), -Derivations and problems.

Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), -Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), -Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

Total : 45 Periods

Text Books

1. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2016.
2. K l after R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2015.

References Books

1. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2016.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co.,2014
3. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2012.
4. Koren Y., “Robotics for Engineers", McGraw Hill Book Co., 2010.

Additional References

NPTEL COURSES

https://nptel.ac.in/courses/112/101/112101098/

https://nptel.ac.in/courses/112/105/112105249/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3		3		2			3				2	3	3
CO 2	3		3		2			3				2	3	3
CO 3	3		3		2			3				2	3	3
CO 4	3		3		2			3				2	3	3
CO 5	3		3		2			3				2	3	3
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	40	40	40	80
Apply				
Analyse				
Evaluate				
Create				

20MEE45	ADVANCED CASTING TECHNIQUES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Manufacturing Technology - I				

Course Objectives

The course is intended to

1. Understand the Casting processes
2. Design the Gate and Riser System
3. Examine the Metallurgical properties of Casting
4. Know the recent trends in Foundry
5. Study and analyze Quality on Casting

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Recall the characteristics of Casting	Remembering
CO 2	Discourse the design considerations in casting	Understand
CO 3	Study the Casting metallurgy properties	Understand
CO 4	Illustrate the various advanced Casting processes	Understand
CO 5	Predict possible ways of Quality improvement on Casting	Applying

Course Contents

UNIT I CASTING PROCESSES 9

Casting Processes, classification, characteristics of sand casting processes, core making materials and their characteristics, Sand additives and mould coatings. Metal mould casting processes, rheo casting.

UNIT II CASTING DESIGN 9

Heat transfer between metal and mould, Design considerations in casting, Designing for directional solidification and minimum stresses, principles and design of gating and riser, Melting and casting quality, Gating and Risering design & analysis

UNIT III CASTING METALLURGY 9

Solidification of pure metal and alloys Rate of solidification, – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys, Babbitt alloy and Cu alloy.

UNIT IV RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 9

Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting

UNIT V MELTING AND QUALITY CONTROL **9**

Melting furnaces and refractories, Melting and quality control of various steels and non-ferrous alloys, casting defects - fettling, inspection and testing of castings. Design for castability- castability analysis and collaborative engineering.

Total : 45 Periods

Text Books

1. Scrope Kalpakjian, "Manufacturing processes for Engineering Materials", Addision, Wesley, 2015
2. P N Rao Manufacturing Technology , Vol 1, 3rd edition ,2011

Reference Books

1. Mikell P. Groover "Fundamental of Modern Manufacturing", Wiley India Edition, Third Edition, Reprint, 2017.
2. Jain P.L., "Principles of Foundry Technology", Tata McGraw Hill Publishers, 2016
3. P.C. Sharma, "A Text Book of Production Technology (Manufacturing Processes)", S.Chand & Company Ltd., New Delhi, 7th Reprint, 2015.

Additional References

1. **Automotive Research Association of India** - https://www.araiindia.com/services/technology-and-products

2. **NPTEL** –https://nptel.ac.in/courses/112107144/13
   https://nptel.ac.in/courses/112107145/17
   https://nptel.ac.in/courses/112107083/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2			3							2		3
CO 2	3	2			3							2		3
CO 3	3	2			3							2		3
CO 4	3	2			3							2		3
CO 5	3	2			3							2		3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Passed in Board of Studies Meeting on 25.02.2022

CHAIRMAN - BOARD OF STUDIES

Passed in Academic Council Meeting on 09.03.2022

CHAIRMAN - ACADEMIC COUNCIL

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20MEE46	ADVANCED WELDING TECHNIQUES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Manufacturing Technology - I				

Course Objectives

The course is intended to

1. Understand the working principle of Welding processes
2. Study the properties of welding
3. study the various welding methods
4. Calculate the heat flow on welded area
5. Analyze the weld joints as per standards

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Recall the various types of welding processes	Remembering
CO 2	Understand and analyze the material structures after welding	Understand
CO 3	Apply the welding techniques for various metal joining	Understand
CO 4	Examine the weldments for various materials.	Understand
CO 5	Attain the knowledge about various welding defects and inspection methods.	Applying

Course Contents

UNIT I WELDING AND JOINING PROCESSES **9**

Introduction to consolidation processes, Classification of welding processes, Design considerations, Heat effects, Weldability and join ability. Welding positions, elements of and construction of welding symbols.

UNIT II WELDING METALLURGY **9**

Need, phase diagrams: Fe-C, Al-Cu, Cu-Zn system, Principle and modes of solidification of weld metal, grain refinement principle of weld metal, method of weld metal refinement, factors affecting changes in microstructure and mechanical properties of HAZ, reactions in weld pool- gas metal reaction, slag metal reaction. Mechanisms, causes and remedy of cold cracking, solidification cracking, nonmetallic inclusions, lamellar tearing, hydrogen damage, banding, segregation.

UNIT III RECENT IN TRENDS IN WELDING **9**

Electro gas and Electro slag, Flux Cored Arc Welding, Explosive welding, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Underwater welding & Microwave welding

UNIT IV HEAT FLOW WELDING **9**

Calculation of peak temperature, Width of Heat Affected Zone (HAZ), cooling rate and solidification rates, weld thermal cycles, residual stresses and their measurement, weld distortion and its prevention

UNIT V WELDMENT INSPECTION AND TESTING **9**

Structural welding code, duties of the inspector, ASTM standards, API standards Chemical, Metallurgical, and Mechanical testing of weldments, Comparison of destructive and non-destructive

tests, chemical tests, Selection of NDT method, Liquid penetrant test, Magnetic particle and Radiographic inspection, Ultrasonic inspection:

Total : 45 Periods

Text Books

1. Parmer R.S., "Welding Engineering and Technology", Khanna Publishers,2015
2. Srinivasan N.K., "Welding Technology", Khanna Tech Publishers, 2017

Reference Books

1. Carrry B., "Modern Welding Technology", Prentice Hall Pvt Ltd., 2012
2. Sindokou, "Welding Metallurgy ", A John Wiley & Sons, Inc., Publication, 2nd edition 2016
3. Edward R. Bohnart, "Welding Principles and Practices", McGraw Hill, 4th Edition.
   ASM Handbook vol.6 2012

Additional References

1. **India Welding Society**- http://www.iws.org.in/relatedwebsites.php
2. **NPTEL** -https://nptel.ac.in/courses/112/107/112107090/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2			3							2		3
CO 2	3	2			3							2		3
CO 3	3	2			3							2		3
CO 4	3	2			3							2		3
CO 5	3	2			3							2		3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Passed in Board of Studies Meeting on 25.02.2022

CHAIRMAN - BOARD OF STUDIES

Passed in Academic Council Meeting on 09.03.2022

CHAIRMAN - ACADEMIC COUNCIL

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20MEE47	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Manufacturing Technology II				

Course Objectives

The course is intended to

1. Define the process planning concepts
2. Identify the process planning activities
3. Estimate the labor cost, material cost and depreciation cost.
4. Determine the production cost estimation
5. Identify the cost estimation for various products after process planning

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 6	Select the process, equipment and tools for various industrial products. .	Remembering
CO 7	Prepare the process planning activity chart.	Remembering
CO 8	Explain the concept of cost estimation.	Understand
CO 9	Compute the job order cost for different type of shop floor.	Understand
CO 10	Calculate the machining time for various machining operations	Understand

Course Contents

UNIT I PROCESS PLANNING **9**

Introduction- methods of process planning – Drawing interpretation – Material evaluation – steps in process selection - Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES **9**

Process parameters calculation for various production processes-Selection jigs and fixtures selection of quality assurance methods - Set of documents for process planning - Economics of process planning - case studies.

UNIT III INTRODUCTION TO COST ESTIMATION **9**

Importance of costing and estimation – methods of costing-elements of cost estimation – Types of estimates – Estimating procedure – Estimation labor cost, material cost - allocation of overhead charges - Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION **9**

Importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planning and Grinding, Cost estimation for machining processes.

UNIT V ESTIMATION OF MACHINING TIME AND COST 9

Importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planning and Grinding, Cost estimation for machining processes.

Total : 45 Periods

Text Books

1. Sinha B.P, "Mechanical estimating and Costing", Tata-McGraw Hill publishing co, 2016.
2. Peterscalon, "Process planning, Design Manufacture Interface", Elsevier science technology Books, Dec-2014.

Reference Books

1. J Chitale A.V. and Gupta R.C., "Product Design and Manufacturing",2nd Edition, PHI,2016.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9thEdition, John Wiley, 2015.
3. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2014
4. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Hanna Publishers 2012..

Additional References

1. **EBook: Process planning and cost estimation**-
   https://www.civilserviceindia.com/subject/Management/notes/process-planning.htm
   https://managementstudyguide.com/planning_disadvantages.htm

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3			1	2		3	2	2	3	2		1
CO 2	3	3			1	2		3	2	2	3	2		1
CO 3	3	3			1	2		3	2	2	3	2		1
CO 4	3	3			1	2		3	2	2	3	2		1
CO 5	3	3			1	2		3	2	2	3	2		1
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	40	40	40	80
Apply				
Analyze				
Evaluate				
Create				

20MEE48	OPERATION RESEARCH	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Manufacturing Technology - I				

Course Objectives

The course is intended to

1. Understand the Linear models and characteristics
2. Identify the Network and Sequencing models
3. Calculate the inventory ,transportation and assignment models
4. Select the process of Queuing theory
5. Identify the decision models and parameters

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Understand the Characteristics and Phases of operation research	Remembering
CO 2	Select the network and sequencing models	Understand
CO 3	Evaluate the inventory, transportation and assignment models	Understand
CO 4	Describe the Queuing models and structures	Understand
CO 5	Understand the principles and application	Understand

Course Contents:

UNIT I LINEAR MODELS 9

Development-Characteristics and Phases of operation research – Types of models –graphical method – simplex algorithm – duality formulation –dual simplex method. Linear Programming Problem – Formulation – Graphical solution – Simplex method – Solution by Excel solver.

UNIT II NETWORK AND SEQUENCING MODELS 9

Network models – shortest route – minimals planning tree – maximum flow models – project network – PERT and CPM networks – critical path scheduling – sequencing models - Flow – Shop sequencing – 'n' jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines

UNIT III INVENTORY, TRANSPORTATION AND ASSIGNMENT MODELS 9

Inventory models – economic order quantity models – safety stock – reorder point – lead time –quantity discount models – transportation problems – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy. Assignment problems – Formulation –Optimal solution –Variants of Assignment Problem.

UNIT IV QUEUING THEORY 9

Queuing models – queuing systems and structures – notation parameter – single server and multi server models – Poisson arrival – exponential service – simulation –Monte Carlo technique - use of random numbers – Exercise problems.

UNIT V DECISION MODELS **9**

Decision models – game theory – two person zero sum games – graphic solution – replacement models – replacement policies – models based on service life–economic life. Dynamic Programming: Introduction – Terminology - Bellman's Principle of Optimality–Applications of dynamic programming - shortest path problem.

Total : 45 Periods

Text Books

1. Taha Hamdy A," Operations Research", Prentice Hall of India Pvt.Ltd.,2016
2. P.K.Gupta&D.S.Hira,"ProblemsinOperationsResearch(Principles&Solutions)",S.Chand&Co. Ltd., 2013.
3. A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi "Operations Research", Pearson Education,2011.

Reference Books

1. Fourer, D.Gay and B. Kernighan, AMPL, "A Modeling Language for Mathematical Programme", Brooks Cole-Thomson,2016.
2. Dharani Venkata Krishnan . S," Operations Research" (Principles&Problems), Keerthi Publishing House Pvt. Ltd., 2012.
3. Don. T. Phillips, Ravindren, A and James Solberg, "Operations Research", John Wiley & Sons,2015.
4. J.K. Sharma "Operation Research" MacMilan.,2012

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2		3				3						
CO 2	3	2		3				3						
CO 3	3	2		3				3						
CO 4	3	2		3				3						
CO 5	3	2		3				3						
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	40	40	40	80
Apply				
Analyze				
Evaluate				
Create				

20MEE49	MANUFACTURING OF COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Engineering Materials and Metallurgy				

Course Objectives

The course is intended to

1. Understand the Basics of composites and fibres
2. Interpret the different types reinforcement of composites
3. Study the Manufacturing methods of Polymer
4. Find the various composite mechanism
5. Examine the Composite structures

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Understand the fundamentals of composite material strength	Remembering
CO 2	Distinguish the construction, constituent's phases & characteristics of the composite materials	Understand
CO 3	Explain the fabrication techniques of different types of composite materials.	Understand
CO 4	Identify the strengthening mechanics adopted in a particular type of composite material.	Understand
CO 5	Analyze the composite material under various load	Applying

Course Contents

UNIT I INTRODUCTION 9

Definition, Classification of Composite materials based on structure, based on matrix. Advantages of composites, application of composites, functional requirements of reinforcement and matrix. Reinforcement types, Fibres, continuous, particulate and whisker reinforcements, Properties, Applications, Comparison of fibre strengths, Matrix materials, Properties. Wettability fibre with matrix, Effect of surface roughness , Interfacial bonding

UNIT II REINFORCEMENTS AND MATRICES 9

Different types of fibers - Manufacturing, properties and applications of glass fibers, carbon fibers, Kevlar fibers, Thermoset and thermoplastic matrices - properties of polyester, epoxy and nylon matrices, polypropylene and PEEK matrices

UNIT III MANUFACTURING OF ADVANCED COMPOSITES 9

Polymer matrix composites: Preparation of Moulding compounds and pre-pregs , hand layup method Autoclave method , Filament winding method , Compression moulding , Reaction injection moulding.

UNIT IV MECHANICS OF LAMINATED COMPOSITES 9

Stress-strain relationship for anisotropic and orthotropic materials - Rule of Mixtures , invariant properties of orthotropic laminates , strength of an orthotropic lamina - failure criteria of orthoptropic lamina - macro mechanical behavior of laminates - classical laminate theory , inter laminar stresses

UNIT V COMPOSITE STRUCTURES 9

Fatigue, S-N curves, Fatigue behaviors of CMCs, Fatigue of particle and whisker reinforced composites, Hybrid composites, and thermal fatigue. Introduction to structures - selection of material, manufacturing and laminate configuration - design of joints - bonded joints - bolted joints - bonded and bolted – laminate optimization.

Total : 45 Periods

Text Books

1. Mallick, P.K., “Fiber Reinforced Composites: Materials, Manufacturing and Design”, Third Edition, Marcel Dekker Inc, 2010.
2. Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites”, John Wiley and Sons, 2015.

Reference Books

1. Autar K. Kaw, “Mechanics of Composite Materials” CRC Press, 2012
2. Robert M. Jones, “Mechanics of Composite Materials” Taylor and Francis, 2012
3. Chawla K.K Composite Materials: Science and Engineering., Springer – Verlag, 2008
4. Ronald Gibson, “Principles of Composite Material Mechanics", Tata McGraw Hill, 2016.

Additional References

1. Automotive Research Association of India - https://www.araiindia.com/services/technology-and-products
2. NPTEL –https://nptel.ac.in/courses/112/104/112104229/
   https://nptel.ac.in/courses/101/104/101104010/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2			3							2		3
CO 2	3	2			3							2		3
CO 3	3	2			3							2		3
CO 4	3	2			3							2		3
CO 5	3	2			3							2		3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Passed in Board of Studies Meeting on 25.02.2022

CHAIRMAN - BOARD OF STUDIES

Passed in Academic Council Meeting on 09.03.2022

CHAIRMAN - ACADEMIC COUNCIL

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20MEE50	CNC MACHINE TOOLS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	**Manufacturing Technology II**				

Course Objectives

The course is intended to

1. Understand the evolution and principle of CNC machine tools
2. Describe the constructional features of CNC machine tools
3. Explain the drives and positional transducers used in CNC machine tools
4. Generate the CNC programs for popular CNC controllers
5. Describe the tooling and work holding devices for CNC machine tools.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Know the basic principles and constructional features in CNC machine tools	Remembering
CO 2	Select the CNC machine tool structure	Understand
CO 3	Identify the DC and AC servomotors	Understand
CO 4	Generate the CNC programming and codes	Understand
CO 5	Choose the tooling and work holding devices in CNC machine tools	Applying

Course Contents

UNIT I INTRODUCTION TO CNC MACHINE TOOLS **6**

Evolution of CNC Technology, principles, features, advantages, applications,CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection

UNIT II STRUCTURE OF CNC MACHINE TOOL **10**

CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.

UNIT III DRIVES AND CONTROLS **9**

Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system– synchro, synchro - resolver, gratings, moiré fringe gratings, encoders, inducto sysn, laser interferometer

UNIT IV CNC PROGRAMMING **11**

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well-known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.

UNIT V TOOLING AND WORK HOLDING DEVICES **9**

Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification- PMK, NSH, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.

Total : 45 Periods

Text Books

1. HMT, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2016.
2. Warren S.Seamers, "Computer Numeric Control", Fourth Edition – Thomson Delmar, 2015.

Reference Books

1. James Madison, "CNC Machining Hand Book", Industrial Press Inc., 2012.
2. Ken Evans, John Polywka& Stanley Gabrel, "Programming of CNC Machines", Second Edition – Industrial Press Inc, New York, 2015.
3. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2012.
4. Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 2010
5. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2015.
6. Rao P.N., "CAD/CAM", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2016.

Additional References

1. NPTEL COURSES –
   a. https://nptel.ac.in/content/storage2/courses/downloads/112105211/noc18_me06_Assignment1.pdf
2. Virtual Lab Courses –
   a. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/exp2/index.html

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3		3		2			3	2	3	2	2	3	3
CO 2	3		3		2			3	2	3	2	2	3	3
CO 3	3		3		2			3	2	3	2	2	3	3
CO 4	3		3		2			3	2	3	2	2	3	3
CO 5	3		3		2			3	2	3	2	2	3	3
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	40	40	40	80
Apply				
Analyze				
Evaluate				
Create				

20MEE51	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Manufacturing Process				

Course Objectives

The course is intended to

1. Understand the basic concepts of supply chain
2. Identify the supply chain network and Framework
3. Explain the logistics in supply chain roles
4. Discuss the sourcing and coordination in supply chain
5. Identify the roles of IT in supply chain

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Outline the roles of Logistics and scope of Chain performance	Remembering
CO 2	Understand the scope of supply chain networks and functions.	Understand
CO 3	Prepare the design option for transportation network, Routing and Scheduling	Understand
CO 4	Select the source of supply chain supplier selection, planning and strategy	Understand
CO 5	Describe the Frame work and customer relationship	Understand

Course Contents

UNIT I INTRODUCTION **9**

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II SUPPLY CHAIN NETWORK DESIGN **9**

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT III LOGISTICS IN SUPPLY CHAIN **9**

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation

UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN **9**

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT V SUPPLY CHAIN AND INFORMATION TECHNOLOGY **9**

The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

Total : 45 Periods

Text Books

1. Sunil Chopra, Peter Meindl and Kalra, “Supply Chain Management, Strategy, Planning, and Operation”, Pearson Education, 2016.

Reference Books

1. Jeremy F.Shapiro, “Modelling the Supply Chain”, Thomson Duxbury, 2010.
2. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management, PHI, 2015
3. David Bloomberg, Stephen Lemay and Joe B.Hanna, “Logistics”, PHI 2016.
4. James B.Ayers, “Handbook of Supply Chain Management”, St.Lucle press, 2015.

Additional References

1. NPTEL Courses - https://nptel.ac.in/courses/110/106/110106045/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3		2		2			2	2	3		2		3
CO 2	3		2		2			2	2	3		2		3
CO 3	3		2		2			2	2	3		2		3
CO 4	3		2		2			2	2	3		2		3
CO 5	3		2		2			2	2	3		2		3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	40	40	40	80
Apply				
Analyze				
Evaluate				
Create				

Passed in Board of Studies Meeting on 25.02.2022

CHAIRMAN - BOARD OF STUDIES

Passed in Academic Council Meeting on 09.03.2022

CHAIRMAN - ACADEMIC COUNCIL

Stream - IV
Automobile Engineering

20MEE61	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Understand the construction and working principle of various parts of an automobile
2. Interpret the different types of ignition systems of the automotive
3. Examine the list and study the mechanism of transmission systems
4. Practice for assembling and dismantling of engine parts and transmission system like Steering, Brakes and Suspension Systems
5. Find the available alternate source of energy for an automotive engines and suggest the future evolution of energy resources

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Recall the various parts of the automobile and their functions and materials	Remembering
CO 2	Discuss the engine auxiliary systems and engine emission control	Understand
CO 3	Illustrate the working of different types of transmission systems	Understand
CO 4	Explain the Steering, Brakes and Suspension Systems	Understand
CO 5	Predict possible alternate sources of energy for automotive Engines	Applying

Course Contents

UNIT I BASICS OF STRUCTURE AND ENGINES 9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC, SI, Electric engines – components-functions and materials, variable valve timing (VVT).

UNIT II COMBUSTION SYSTEMS AND NORMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III TRANSMISSION AND DRIVE SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

UNIT IV CONTROL SYSTEMS OF AUTOMOBILE **9**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic, Magnetic and Hydraulic Braking Systems, Antilock Braking System (ABS),electronic brake force distribution (EBD) and Traction Control

UNIT V ALTERNATIVE FUELS **9**

Compressed Natural Gas(CNG), Liquefied Petroleum Gas(LPG), Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell

Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

Total : 45 Periods

Text Books

1. Kirpal Singh, “Automobile Engineering”, Vol 1 &2,Standard Publishers, New Delhi, 14th Edition 2018
2. V. Ganesan , Internal Combustion Engineering, New Delhi :Tata McGraw-Hill Publishing Co, 2012.
3. Devendra Vashist, Manav Rachna, “Automobile Engineering”, Dreamtech Press, New Delhi, February 2020

Reference Books

1. Robert Bosch, “Bosch Automotive Handbook”, Published by Robert Bosch with a Product Code of BOSCH10, ISBN of 978-0-7680-9567-8, 10th Edition 2018
2. S Srinivasan, “Automotive Mechanics”, McGraw Hill Education; 2nd edition July 2017
3. S K Gupta, “Textbook of Automobile Engineering”,S Chand & Co Ltd, 2014
4. Heinz Heisler, “Advanced Combustion,” SAE International Publications USA, 2005.

Additional References

1. **Automotive Research Association of India** - https://www.araiindia.com/services/technology-and-products
2. **NPTEL** - https://nptel.ac.in/courses/107/106/107106088/
3. **MOOC Courses** - https://www.mooc-list.com/tags/automotive-engineering
4. **Virtual laboratory – Ministry of Education** - https://www.vlab.co.in/broad-area-mechanical-engineering

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2			3							2		3
CO 2	3	2			3							2		3
CO 3	3	2			3							2		3
CO 4	3	2			3							2		3
CO 5	3	2			3							2		3
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

20MEE62	AUTOMOTIVE TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Automobile Engineering				

Course Objectives

The course is intended to

1. Understand the construction and working principle of various parts of an automobile transmission
2. Know the various transmission and drive line units of automobiles
3. Utilizing appropriate safety procedures, Perform general transmission and transaxle diagnosis
4. Examine automatic transmission and transaxle maintenance and adjustments;
5. Practice for in-vehicle and off-vehicle automatic transmission and transaxle repair.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Recall the various parts of the clutch and gearbox and their functions	Remembering
CO 2	Discuss the principles of hydrodynamic transmission systems	Understand
CO 3	Illustrate automatic drive train inspection, maintenance, diagnosis and repairs.	Understand
CO 4	Develop and implement strategies and processes to solve automatic drive train repair problems.	Understand
CO 5	Predict automatic drive train repair to professional and ethical standards.	Understand

Course Contents

UNIT I CLUTCH AND GEAR BOX 9

Requirement of transmission system, Different types of clutches, principle & Construction of Single plate coil spring and Diaphragm spring clutches, Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchromesh gearboxes. – Determination of gear ratios for vehicles. Performance characteristics in different speeds. Resistance to motion, Tractive effort, Engine speed & Power and acceleration.

UNIT II HYDRODYNAMIC TRANSMISSION 9

Fluid coupling-Principle-Constructional details. Torque capacity. Performance characteristics. Reduction of drag torque in fluid coupling. Torque converter-Principle-constructional details, performance characteristics. Multistage torque converters and Polyphone torque converters.

UNIT III EPICYCLIC GEARBOXES USED IN AUTOMATIC TRANSMISSION 9

Principle of Planetary gear trains - Wilson Gear box, Cotal electromagnetic transmission-Hydraulic control system for Automatic Transmission.

UNIT IV AUTOMATIC TRANSMISSION APPLICATIONS **9**

Need for automatic transmission, Four speed longitudinally mounted automatic transmission - Chevrolet “Turbo glide” Transmission, Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT.

UNIT V HYDROSTATIC AND ELECTRIC DRIVE **9**

Hydrostatic drive; Various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive. Electric drive-types- Principle of early and modified Ward Leonard Control system-Advantages & limitations.

Total : 45 Periods

TEXT BOOKS:

1. Newton and Steeds, "Motor vehicles", Illiffe Publishers, 2000.
2. Devaradjane. G., Kumaresan. M., "Automobile Engineering", AMK Publishers, 2013.
3. P.M. Heldt, Automotive Chassis, New York: Chilton Co, 2014

REFERENCES:

1. Crouse,W.H., Anglin,D.L.," Automotive Transmission and Power Trains construction", McGraw Hill, 2016.
2. Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2002.
3. K. Singh, Automobile Engineering-Volume 1, Delhi: Standard Publishes Distributors, 2012.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2	2		3					3				3
CO 2	3	2	2		3					3				3
CO 3	3	2	2		3					3				3
CO4	3	2	2		3					3				3
CO 5	3	2	2		3					3				3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	40	40	40	80
Apply				
Analyse				
Evaluate				
Create				

20MEE63	VEHICLE BODY ENGINEERING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Automobile Engineering				

Course Objectives

The course is intended to

1. The main objective of this course is to impart knowledge in the construction of vehicle, aerodynamic, concept, panelling of passenger car body trim.
2. At the end of the course the student will be well versed in the design and construction of external body of the vehicles.
3. Calculate various aerodynamic forces and moments acting on vehicle.
4. Calculate load distribution in vehicle body.
5. Explain the ergonomics, stability the vehicle.

Course Outcomes

Upon completion of the course, students will

CO.No	Course Outcome	Bloom's Level
CO 1	Recall about different aspects of car body and bus body, types, commercial vehicle.	Remembering
CO 2	Role of various aerodynamic forces and moments, measuring instruments	Understand
CO 3	Illustrate about the material used in body building, tools used, body repairs.	Understand
CO 4	Explain the concept, importance and testing of aerodynamics in car body design.	Understand
CO 5	Predict the different vehicle body materials with their merits and demerits	Understand

Course Contents

UNIT I CAR BODY DETAILS 9

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car – Visibility regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car body construction-Various panels in car bodies. Safety aspect of car body.

UNIT II BUS BODY DETAILS 9

Types of bus body: based on capacity, distance travelled and based on construction.– Bus body lay out for various types, Types of metal sections used – Regulations – Constructional details: Conventional and integral. Driver seat design- Safety aspect of bus body.

UNIT III COMMERCIAL VEHICLE DETAILS 9

Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of commercial vehicle body - Flat platform body, Trailer, Tipper body and Tanker body – Dimensions of driver's seat in relation to controls – Drivers cab design - Regulations.

UNIT IV VEHICLE AERODYNAMICS 9

Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation, Types. Wind tunnel testing such as: Flow visualization techniques, Airflow management test – measurement of various forces and moments by using wind tunnel.

UNIT V BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR 9

Types of materials used in body construction-Steel sheet, timber, plastics, GRP, properties of materials. Body trim items-body mechanisms. Hand tools-power tools-panel repair-repairing sheet metal-repairing plastics-body fillers-passenger compartment service- corrosion: Anticorrosion methods, Modern painting process procedure-paint problems

Total : 45 Periods

TEXT BOOKS:

1. A.K Babu, "Vehicle Body Engineering", Khanna Book Publishing, 2021
2. Automobile Chassis and Body Engineering –Prof K V Fadadu, B H Kadiys, Books India Publications 1st edition 2016.
3. Vehicle body layout and analysis - John Fenton, Mechanical Engg. Publication ltd, London.

REFERENCES:

1. L. Morello, L.R. Rossini, G. Pia and A. Tonoli, the Automotive Body, Volume I: Components Design, London: Springer, 2011.
2. J. Fenton, Handbook of Automotive Body Construction and Design Analysis, New Delhi: Wiley India, 2010.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2		3						3				3
CO 2	3	2		3						3				3
CO 3	3	2		3						3				3
CO 4	3	2		3						3				3
CO 5	3	2		3						3				3
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	40	40	40	80
Apply				
Analyse				
Evaluate				
Create				

20MEE64	ALTERNATE FUELS FOR AUTOMOBILES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Automobile Engineering				

Course Objectives

The course is intended to

1. Know about the types of alternative fuels and energy sources for IC engines.
2. Present a problem oriented in depth knowledge of Alternate fuel and energy system.
3. Address the underlying concepts and methods behind alternate fuel and energy system.
4. Develop professional fundamentals and understand energy infrastructure in alternative fuels.
5. Comprehend traditional, alternative, and sustainable energy production technologies.

Course Outcomes

On completion of the course, the student will

CO.No	Course Outcome	Bloom's Level
CO 1	Understand the various alternative fuels available and its properties.	Remembering
CO 2	Illustrate the performance characteristics and combustion characteristics.	Understand
CO 3	Explain the various emission characteristics	Understand
CO 4	Identify the engine modifications required and performance.	Understand
CO 5	Can find the applications of all the areas in day to day life.	Understand

Course Contents

UNIT I ALCOHOLS AS FUELS **9**

Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNIT II VEGETABLE OILS AS FUELS **9**

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Trans esterification and emulsification of Vegetable oils - Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.

UNIT III HYDROGEN AS ENGINE FUEL **9**

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage - safety aspects of hydrogen.

UNIT IV BIOGAS, NATURAL GAS AND LPG AS FUELS **9**

Production methods of Biogas, Natural gas and LPG. Properties studies. CO2 and H2S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines

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UNIT V ELECTRIC, HYBRID AND FUEL CELL VEHICLES **9**

Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

Total : 45 Periods

TEXT BOOK:

1. "Alternate Fuels" by Dr. S. Thipse, Jaico Publications,2010
2. "Automotive Fuel and Emission Control" by James D. Halderman, James Linder Pearson, 3rd edition 2011.
3. V. Ganesan, "Internal Combustion Engines", New Delhi : Tata Mcgraw Hill Publishing Co. Ltd, 2012

REFERENCES:

1. Devaradjane. Dr. G., Kumaresan. Dr. M.,Automobile Engineering, AMK Publishers, 2013.
2. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 2014.
3. Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels, 2014.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2						2				2		3
CO 2	3	2						2				2		3
CO 3	3	2						2				2		3
CO 4	3	2						2				2		3
CO 5	3	2						2				2		3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	40	40	40	80
Apply				
Analyse				
Evaluate				
Create				

20MEE65	AUTOMOTIVE EMISSION AND CONTROL	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	I.C. Engines				

Course Objectives

Students undergoing this course are expected to

1. Develop the basic knowledge of the students in automobile engines pollution formation
2. Interpret the different types of control techniques, Measurement techniques
3. Know the social, cultural, global and environmental responsibilities of the professional engineer
4. Find the available principles of sustainable design and development.
5. Develop professional fundamentals and understand about measurement techniques.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Describe the emission and its effect on human health and environment.	Remembering
CO 2	Identify the formation of pollutant in SI engine.	Understand
CO 3	Explain the formation of pollutant in CI engine	Understand
CO 4	Describe the Emission control techniques.	Understand
CO 5	Predict the Emission measurement techniques, Emission Standards and various test procedure.	Understand

Course Contents

UNIT I INTRODUCTION **9**

Vehicle Population Assessment in Metropolitan Cities and Contribution to Pollution, Effects on Human Health and Environment, Global Warming, Types of Emission (Controlled and Uncontrolled Emissions), Transient Operational Effects on Pollution.

UNIT II POLLUTANT FORMATION IN SI ENGINES **9**

Pollutant Formation in SI Engines, Mechanism of HC and CO Formation in Four Stroke and Two Stroke SI Engines, NOx Formation in SI Engines, Effects of Design and Operating Variables on Emission Formation, Evaporative Emission. Two Stroke Engine Pollution.

UNIT III POLLUTANT FORMATION IN CI ENGINES **9**

Pollutant Formation in CI Engines, Smoke and Particulate Emissions in CI Engines, Effects of Design and Operating Variables on CI Engine Emissions, NOx Formation

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CHAIRMAN - ACADEMIC COUNCIL

UNIT IV CONTROL OF EMISSIONS FROM SI AND CI ENGINES **9**

Design of Engine, Optimum Selection of Operating Variables for Control of Emissions, EGR, Catalytic Converters, Catalysts, Fuel Modifications, Two Stroke Engine Pollution Controls. SCR, Lean NOx Trap and DPF, PCV, Fuel Charcoal Canister.

UNIT V MEASUREMENT TECHNIQUES EMISSION STANDARDS AND TEST PROCEDURE **9**

NDIR, FID, Chemiluminescent Analyzers, Gas Chromatograph, Smoke Meters, Emission Standards, Driving Cycles – USA, Japan, Euro and India. Test Procedures – ECE, FTP Tests. SHED Test – Chassis Dynamometers, Dilution Tunnels.

Total : 45 Periods

Text Books.

1. Engine Emissions, Pollutant formation and Measurement by George Springer, Springer 2012.
2. J.D. Halderman and J. Linder, Automotive Fuel and Emissions Control Systems, NJ: Pearson Education, 4th edition 2016.
3. B.P. Pundir, Engine Emissions: Pollutant Formation and Advances in Control Technology, New Delhi: Narosa Publishing House, 2017.
4. M. Adachi and H. Nakamura, Eds., Engine Emissions Measurement Handbook, PA: SAE International, 2014.

Reference Books

1. B. L. Singhal , Prof. (Dr.) D. R. Shah "Internal Combustion Engines"- Tech Knowledge Publications, 2020
2. Wladyslaw Mitianiec "Fundamentals of Fuel Injection and Emissions from two stroke engines, Nova Science Publishers Inc 2018.
3. M.K.Khair and W.A.Majewski, Diesel Emissions and Their Control, PA: SAE International, 2014.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3		3						3					3
CO 2	3		2						3					3
CO 3	3		3						3					3
CO 4	3		3						3					3
CO 5	3		3						3					3
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	20	20	20
Understand	80	80	80	80
Apply				
Analyse				
Evaluate				
Create				

20MEE66	TWO AND THREE WHEELERS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Automotive chassis				

Course Objectives

Students undergoing this course are expected to

1. Develop the basic knowledge of the students in constructional details of two and three Wheelers.
2. Know the basic knowledge of the students in constructional details of clutches.
3. Interpret the different types of brakes and tyres
4. Examine the list and study the various two wheeler models.
5. Explain the list and study the various three wheeler models.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Know the working of two and four stroke engines	Remembering
CO 2	Explain the functioning of clutch and gear box	Remembering
CO 3	Discuss the wheels, tyres, suspensions and braking systems	Understand
CO 4	Familiarize the latest models of two wheelers	Understand
CO 5	Find the available operations of three wheelers and latest models of three wheelers	Understand

Course Contents

UNIT I POWER UNIT **9**

Two Stroke SI Engine, Four Stroke SI Engine - Merits and Demerits. Symmetrical and Unsymmetrical Port Timing Diagrams. Types of Scavenging Processes: Merits and Demerits, Scavenging Pumps. Rotary Valve Engine, Fuel System, Lubrication System. Magneto Coil and Battery Coil Spark Ignition System, Electronic Ignition System. Starting System - Kick Starter System.

UNIT II CHASSIS AND SUB-SYSTEMS **9**

Mainframe and Its Types - Chassis and Shaft Drive - Single, Multiple Plates and Centrifugal Clutches. Gear Box and Gear Controls - Front and Rear Suspension Systems - Shock Absorbers - Panel Meters and Controls on Handle Bar.

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CHAIRMAN - ACADEMIC COUNCIL

UNIT III BRAKES, WHEELS AND TYRES **9**

Drum Brakes, Disc Brakes, Front and Rear Brake Links, Layouts - Spoke Wheel, Cast Wheel, Disc Wheel and Disc Types - Tyres and Tubes.

UNIT IV TWO WHEELERS **9**

Study and Comparison of Specification and Features of Major Indian Models of Mopeds, Scooters and High Performance Vehicles. Injection Systems, Silencer Design and After Treatment Devices.

UNIT V THREE WHEELERS **9**

Study and Comparison of Specification and Features of Indian Models. Auto Rickshaws, Pickup Van, Delivery Van and Trailer. Maintenance & Fault Tracing, Injection Systems, Silencer Design and After Treatment Devices

Total : 45 Periods

Text Books

1. Dhruv U. Panchal,Two and three wheeler Technology, 1st Edition, 2015
2. Irving.P.E. - Motor Cycle Engineering - Veloce Enterprises, Inc., 2017
3. Ramalingam. K. K., “Two Wheelers”, Scitech publications, Chennai, 2009.

Reference Books

1. D.U .Panchal, Two and Three Wheeler Technology, New Delhi: PHI Learning Private Ltd, 2015
2. https://nptel.ac.in/courses/105107123/3

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3				3		3							2
CO 2	3				3		3							2
CO 3	3				3		3							2
CO 4	3				3		3							2
CO 5	3				3		3							2
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	40	40	40	40
Understand	60	60	60	60
Apply				
Analyse				
Evaluate				
Create				

20MEE67	OFF ROAD VEHICLES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	NIL				

Course Objectives

Students undergoing this course are expected to

1. Understand the basics of off road vehicles.
2. Explain the constructional features and working of earth movers.
3. Illustrate the constructional features and working of Shovels, ditchers, scrappers, graders.
4. Describe the constructional features and working of farm equipments, military and combat vehicles.
5. Know about the vehicle systems and features.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Know the fundamental knowledge about various type of off road vehicles.	Understand
CO 2	Understand the special features about the earth moving machines and other off road vehicles.	Understand
CO 3	Select and apply the appropriate design methodology for the off road vehicles.	Understand
CO 4	Illustrate the knowledge about the working principle for various type of off road vehicles.	Apply
CO 5	Remember the knowledge about application of the off road vehicles and can apply the new methodology to improve the performance of the vehicles.	Apply

Course Contents

UNIT I CLASSIFICATION OF OFF ROAD VEHICLES 9

Introduction to off road vehicles – Classification: Construction layout, capacity and applications, Power Plants, Chassis and Transmission and Multi-axle vehicles.

UNIT II EARTH MOVING AND MATERIAL HANDLING MACHINES 9

Earthmovers like dumpers, loaders, dozers, excavators, backhoe loaders, bush cutters, stumpers, and rippers – Power, Capacity and Mechanisms of earth moving machines. Material handling vehicles used in the industries – Hydraulic and Electric drives.

UNIT III SCRAPPERS ,GRADERS, SHOVELS AND DITCHERS 9

Scrappers, elevating graders, motor graders, self-powered scrappers and graders, Power shovel, revolving and stripper shovels – drag lines – ditchers – Power, Capacity and Mechanisms of mining machines.

UNIT IV FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES 9

Constructional details of Tractors - power take off, special implements. Case study of any one tractor. Special features and constructional details of tanks, gun carriers and military transport vehicles.

UNIT V VEHICLE SYSTEMS, FEATURES 9

Brake system and actuation – OCDB and dry disc calliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler.

Total : 45 Periods

Text Books

1. Robert Peurifoy, Clifford J. Schexnayder, Aviad Shapira, Robert Schmitt, “Construction Planning, Equipment, and Methods”, Tata McGraw-Hill Education Pvt. Ltd., 2011.
2. Nakra C.P., “Farm machines and equipments”, Dhanparai Publishing company Pvt. Ltd. 2003.
3. Zhaochoao Yong Li Ziguang., "Road Construction machinery", S.K. Kataria, 2018.
4. Wong.J.Y. "Theory of Ground Vehicles”, Hardcover 2008.

Reference Books

1. I.S. Ageikin, Off the road wheeled and combined traction devices, CRC Press, 2004.
2. Schulz Erich.J, Diesel equipment I &II, Mcgraw Hill Company, London, 2005.
3. Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co Ltd London.
4. Satyanarayana. B., Construction planning and equipment, standard publishers and distributors,New Delhi.
5. H.P. Smith, Farm Machinery and Equipment, Belgium: Morse Press, 2011.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	2	3		3		1								2
CO 2	2	3		3		1								2
CO 3	2	3		3		1								2
CO 4	2	3		3		1								2
CO 5	2	3		3		1								2
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	40	40	40	20
Understand	60	60	60	80
Apply				
Analyse				
Evaluate				
Create				

20MEE68	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	NIL				

Course Objectives

Students undergoing this course are expected to

1. Give the students the idea of global energy scenario, pollution levels and green mobility technology solutions
2. Make the students understand the basics of traction batteries, their operating characteristics, charging and management system.
3. Understand the basics of power electronics used in hybrid and electrical vehicles
4. Explain the characteristics of traction motors, their performance and vehicle performance
5. Familiarize with electromagnetic interference and EV testing standards.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Illustrate the concept of electric vehicles and its propulsion systems	Understand
CO 2	State the concept of hybrid architecture and power plan**.**	Understand
CO 3	List the energy storage systems.	Understand
CO 4	Explain about the fuel cells	Apply
CO 5	Illustrate the non electric hybrid propulsion systems	Apply

Course Contents

UNIT I INTRODUCTION **9**

Global energy scenario - Electric and hybrid vehicle - need, advantages, challenges - layout, components. Hybrid vehicle – advantages, disadvantages, architecture – series, parallel, plug-in, mild and assist hybrid. Hybrid vehicle operating modes – Fuel cells – basics, types, advantages and disadvantages**.**

UNIT II TRACTION BATTERIES **9**

Targets and properties of batteries, Li-Po battery, Li ion battery, Nickel Metal Hydride Battery, Sodium Sulphur Battery and Aluminium Air Battery, Super capacitors. Battery charging - battery charging profile charging time –charging standards – charging methods – charging modes – vehicle to grid technology – Tesla power wall –Wireless power transfer – Regenerative Braking - Battery management System**.**

UNIT III POWER ELECTRONICS FOR EV AND HEV **9**

Semiconductor power diodes, transistors, thermistors, trials, GTOs. AC-DC converters, DC-DC converters and types – buck, boost, fly back. Isolated converters. Inverters based on MOSFET. Microcontrollers/DSP based controllers, Types of sensors for electric drive, Current sensors and signal conditioners.

UNIT IV MOTORS FOR ELECTRIC VEHICLE **9**

Introduction –Motor and engine ratings- motor torque and power characteristics – EV motor sizing -Construction and working principle of DC machines, BLDC Motor, three phase AC machines, PM and SR machines – Design criteria of DC motor drives, induction motor drives and PM/SRM motor drives for EVs. –Acceleration Performance and Vehicle Power - Final Drive - Speed Calculation with a Torque Profile

.

UNIT V ELECTROMAGNETIC INTERFERENCE & EV TESTING **9**

EMI – Noise propagation modes – cabling – components – PCB EMC – SAE Automotive EMC standards – SAEJ551- SAE J 1113 – Test methodology - Need for testing EVs – Safety checklist (AIS 038). – significance of isolation resistance - measurement of isolation resistance – water tests(flood test/ wash test/ rain test) motor power test (AIS 041) – chassis dynamometer – motor dynamometer (motor test bed) – Energy consumption test(AIS 039) – battery testing (AIS 048) – steps for reducing the energy consumption – Range test (AIS 040) –FAME scheme of INDIA.

Total : 45 Periods

Text Books

1. Tom Denton. “Electric and Hybrid Vehicles” Routledge Publications, 2016.
2. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Boca Raton: CRC Press, 2018.
3. Ali Emadi, Handbook of Automotive Power Electronics and Motor Drives, CRC Press, 2017

Reference Books

1. Chau. K. T. “Electric Vehicle Machines and Drives – Design, Analysis and Application”, John Wiley & Sons Singapore Pte. Ltd., 2015
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 24-Oct-2014
3. Power Electronics and Motor Drives, Bogdan M. Wilamowski, J. David Irwin, CRC Press, 2016

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3		3		2									3
CO 2	3		3		2									2
CO 3	3		3		2									2

CO 4	3		3		2									2
CO 5	3		3		2									2
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	30	30	30	60
Understand	20	20	20	40
Apply				
Analyse				
Evaluate				
Create				

20MEE69	VEHICLE MAINTENANCE	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	NIL				

Course Objectives

Students undergoing this course are expected to

1. Understand the classification of maintenance work, vehicle insurance, workshop practices, safety and tools
2. Illustrate the general engine services, engine subsystem maintenance and engine maintenance.
3. Explain the transmission and driveline maintenance
4. Discuss about the steering, brake, suspension and wheel maintenance
5. Predict the auto electrical and air conditioning maintenance

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Describe the importance, types and requirements of vehicle maintenance and related records and schedules.	Understand
CO 2	Practice the engine overhauling, reconditioning; methods, procedures, tools of cylinder, valves and other engine components .	Apply
CO 3	Demonstrate the maintenance procedures of clutch, gearbox, steering system, braking system, wheel alignment, door actuating systems and body tinkering	Apply
CO 4	Explain the construction, testing, fault diagnosis and maintenance of battery, starter motor, alternator, DC generator, ignition, lighting and dashboard instruments	Understand
CO 5	Illustrate the different service and maintenance aspects of fuel system, lubrication system and calibrate of fuel injection pump	Understand

Course Contents

UNIT I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS 9

Maintenance – Need, classification of maintenance work – policies- vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual and records, Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools –special service tools – measuring instruments –Motor vehicle Act, traffic rules, driving rules and regulations

UNIT II ENGINE AND ENGINE SUB SYSTEM MAINTENANCE **9**

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection engine management- emission controls service and fault diagnosis.

UNIT III TRANSMISSION AND DRIVELINE MAINTENANCE **9**

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings servicing differential assemblies- fault diagnosis**.**

UNIT IV STEERING, BRAKE, SUSPENSION, WHEEL MAINTENANCE **9**

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage, steering system and types.

UNIT V AUTO ELECTRICAL AND AIR CONDITIONING MAINTENANCE **9**

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting**.**

Total : 45 Periods

Text Books

1. Currie, Robert P, Currie, Michelle B, Keen, George M “Fleet Management”, Wandering Brothers Publishing, 2006
2. Ed May, "Automotive Mechanics Volume One" , McGraw Hill Publications, 2003
3. Ed May, "Automotive Mechanics Volume Two" , McGraw Hill Publications, 2003

Reference Books

1. Bosch Automotive Handbook, Sixth Edition, 2004
2. James D Halderman - Advanced Engine Performance Diagnosis – Pearson, 2011.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3		2			2					1			2
CO 2	3		2			2					1			2
CO 3	3		2			2					1			2
CO 4	3		2			2					1			2
CO 5	3		2			2					1			2
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	30	30	30	80
Understand	20	20	20	20
Apply				
Analyse				
Evaluate				
Create				

20MEE70	SMART MOBILITY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	NIL				

Course Objectives

Students undergoing this course are expected to

1. Develop an understanding of system engineering processes.
2. Learn about Advanced Transportation Management System
3. Explain the capability of key technologies
4. Knowing the methods of vibration and noise measurement.
5. Understand how to evaluate technologies, applications and services

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Understand Smart Transportation Systems Advanced Traffic Management Systems	Understand
CO 2	Explain about Advanced Transportation Management System	Apply
CO 3	Know about APTS, CVO, new technology and ETC	Understand
CO 4	Describe about measurement techniques of noise, vibration pertain to an automobile	Understand
CO 5	Summarizes about STS issues in terms of various factors and emerging issues.	Apply

Course Contents

UNIT I INTRODUCTION **9**

Introduction to the Concept of Automotive Electronics- Body, Chassis and Power train Electronics, Advanced Driver Assistance Electronic Systems. Basic Control System Theory applied to Automobiles-Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy.

UNIT II SENSOR TECHNOLOGY FOR AUTOMATED VEHICLES **9**

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT III COMPUTER VISION AND DEEP LEARNING **9**

Introduction, Computer Vision: Computer Vision Fundamentals, Deep Learning:- Neural Networks, Deep Neural Networks, Convolutional Neural Networks, Keras ,Tensor Flow, Sensor Fusion:- Kalman Filters

UNIT IV LOCALISATION AND PATH PLANNING **9**

Introduction to Localization- Motion Models, Particle Filters, Implementation of a Particle Filter, Path Planning: -search, prediction, behaviour planning, trajectory generation, Control-PID, System Integration-ROS Driverless Car Technology: - Moral, Legal, Roadblock Issues, Technical Issues, Security Issues

UNIT V CONNECTED CAR TECHNOLOGY **9**

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Wireless Security Overview Connected Car Display Technology- Center Console Technology, Gauge Cluster Technology, Heads-Up Display Technology, Warning Technology-Driver Notification.

Total : 45 Periods

Text Books

1. Markus Maurer, J. Christian Gerdes, Barbara Lenz, Hermann Winner , Autonomous Driving: Technical, Legal and Social Aspects, Springer,2016
2. Hod Lipson, Melba Kurman, Driverless: Intelligent Cars and the Road Ahead, MIT press, 2016
3. Michael E. McGrath, Autonomous Vehicles: Opportunities, Strategies, and disruptions, 2016.
4. R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Third Edition, 2004.

Reference Books

1. Vivekwadhwa , Alex salkever, The driver in the driverless car, 2017
2. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010
3. Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2			2		2							2
CO 2	3	2			2		2							2
CO 3	3	2			2		2							2
CO 4	3	2			2		2							2
CO 5	3	2			2		2							2
	3-High				**2-Medium**				**1-Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	30	30	30	80
Understand	20	20	20	20
Apply				
Analyse				
Evaluate				
Create				

Open Electives

20MEO01	INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3
Nature of course	**OPEN ELECTIVE COURSE**				
Pre requisites	**NIL**				

Course Objectives

The course is intended to

1. Understand the global trends and development methodologies of various types of products and services
2. Conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
3. Understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
4. Understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
5. Develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Summarize the various trends affecting product decision	Understand
CO 2	Identify the requirements to create new product	Apply
CO 3	List the different techniques involved in design creation and design testing.	Remembering
CO 4	Illustrate the need of end of life and patenting.	Understand
CO 5	Apply the knowledge on values of product development and engineering service industries in business.	Apply

Course Contents

Unit – I FUNDAMENTALS OF PRODUCT DEVELOPMENT **9**

Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management

Unit – II REQUIREMENTS AND SYSTEM DESIGN **9**

Requirement Engineering - Types of Requirements - Requirement Engineering -traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization.

Unit – III DESIGN AND TESTING **9**

Conceptualization - Industrial Design, Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines – Concept Screening & Evaluation - Detailed Design - Component Design and Verification, Introduction to Rapid Prototyping, Testing, Certification and Documentation

Unit – IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT **9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair.

Unit – V **Introduction to Intellectual Property Rights (Ipr)** **9**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, Research Hypothesis, Innovation, patenting development, Citation, International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents.

Total : 45 Periods

Text Books

1. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
2. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005

Reference Books

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	1	-	-	-	1	1	1	1	-	-	1	-	3
CO 2	3	1	-	-	-	1	1	1	1	-	-	1	-	3
CO 3	3	1	-	-	-	1	1	1	1	-	-	1	-	3
CO 4	3	1	-	-	-	1	1	1	1	-	-	1	-	3
CO 5	3	1	-	-	-	1	1	1	1	-	-	1	-	3
	3	**High**				**2**	**Medium**					**1**	**Low**	

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20MEO02	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3
Nature of course	**OPEN ELECTIVE COURSE**				
Pre requisites	**NIL**				

Course Objectives

The course is intended to

1. Understand the basic concepts of sand-casting technique and special casting technique.
2. Understand the principles, equipment's of different welding techniques.
3. Know the various operations and equipment requirements of hot and cold metal forming processes.
4. Familiarize the working principle and applications of different types of sheet metal processes.
5. Demonstrate the working principles of different types of thermo plastic manufacturing methods.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Summarize the concepts of basic manufacturing processes, metal casting processes and melting furnaces.	Understand
CO 2	Describe the working principles of arc welding, gas welding and special welding processes.	Understand
CO 3	Demonstrate different manufacturing processes, hot and cold working processes with their typical applications	Apply
CO 4	Describe the sheet metal characteristics, operations, and special forming processes.	Remembering
CO 5	Select various types of plastic injection molding processes and typical applications.	Remembering

Course Contents

Unit – I METAL CASTING **9**

Sand Casting: Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces: Blast and Cupola Furnaces.

Unit – II METAL JOINING PROCESSES **9**

Operating principle, basic equipment, merits and applications of: arc welding processes: Gas Tungsten arc welding Gas metal arc welding, Brazing and soldering; Weld defects: types, causes and cure. Adhesive bonding.

Unit – III METAL FORMING PROCESSES **9**

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations- Principle of rod and wire drawing – Tube drawing.

Unit – IV SHEET METAL PROCESSES **9**

Sheet metal processes – blanking, piercing, shearing, bending, slotting, perforating, notching and drawing. Construction simple and compound die.

Unit – V MANUFACTURE OF PLASTIC COMPONENTS **9**

Injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – introduction to blow moulding - Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

Total : 45 Periods

Text Books

1. Hajra Choudhary. S.K and Hajra Choudhary. A.K., "Elements of Workshop Technology", volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 2010.
2. Kalpakjian. S, “Manufacturing Engineering and Technology”, 7th Edition, Pearson Education India Edition, 2018

Reference Books

1. Roy A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
2. Black J.T and Ronald A. Kosher, "Degarmos Materials and Processes, in Manufacturing" 12th Edition, Wiley Publishers, 2017.
3. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2006
4. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", Vol 1, 4th Edition, McGraw Hill-2017.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	2	1	1	-	-	1	2	-	-	-	1	1	-	2
CO 2	2	1		-	-	1	2	-	-	-	1	1	-	2
CO 3	2	1	1	-	-	1	2	-	-	-	1	1	-	2
CO 4	2	1	1	-	-	1	2	-	-	-	1	1	-	2
CO 5	2	1	1	-	-	1	2	-	-	-	1	1	-	2
	3	**High**				**2**	**Medium**					**1**	**Low**	

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	20	20	20	**40**
Understand	20	20	20	**40**
Apply	10	10	10	**20**
Analyze				
Evaluate				
Create				

20MEO03	AUTOMOTIVE TECHNOLOGY	L	T	P	C
		3	0	0	3
Nature of course	**OPEN ELECTIVE COURSE**				
Pre requisites	**NIL**				

Course Objectives

The course is intended to

1. Understand the various types of automobiles, their power packs, and types of vehicle bodies.
2. Differentiate the various types of power train and fuel supply and management systems
3. know the various types of transmission systems for a vehicle
4. Understand the working parameters of various braking and suspension system in a vehicle.
5. Summaries the working parameters of various electrical and electronic devices in a vehicle

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Describe the various types of automobiles, their power packs, and types of vehicle bodies.	Remembering
CO 2	Describe various types of power train and fuel supply and management systems	Understand
CO 3	Identify different types of transmission systems for a vehicle	Understand
CO 4	discover the concepts and working principles of various braking and suspension system in a vehicle	Apply
CO 5	Interpret the working parameters of various electrical and electronic devices in a vehicle	Apply

Course Contents

Unit – I INTRODUCTON TO AUTOMOBILE AND TYPES **9**

An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Types of power delivery, Safety standards. Regulations, Car body construction. Bus Body Details, General consideration relating to chassis layout.

Unit – II FUEL MANAGEMENT SYSTEMS **9**

Reciprocating Engine systems, Hybrid systems. Working principle of an electric vehicles, fuel cells. Liquid and gaseous alternate fuels - Alcohol, LPG, CNG, and Hydrogen

Unit – III TRANSMISSION SYSTEMS **9**

Clutch system and types, Gear box and types - manual, automatic, and AMT, Wheels, Tyres - types, construction and specification, types of suspension systems.

Unit – IV BRAKING AND STEERING SYSTEMS **9**

Braking system - requirements and types, Antilock breaking systems, Steering system - working, types and power steering. Wheel balancing & Alignment, Maintenance of Vehicles

Unit – V ELECTRICAL AND ELECTRONIC SYSTEMS **9**

Introduction to Battery, Alternator, and Starter Motor systems, working principle, and circuitry, Safety systems - seat belts, air-bag, Modern electronic features in vehicles like tyre pressure monitoring, ESP, EBD, Automatic headlamp ON, Rain sensing wipers, speed sensing auto locking.

Total : 45 Periods

Text Books

1. Jack Erjavek, “Automotive Technology – A Systems Approach”, Thomson Learning, 6th Edition, 2014
2. William H. Crouse and Donald L. Anglin, “Automotive Mechanics”, Tata McGraw Hill, 10th Edition, 2017

Reference Books

1. Gill P.S., “A Textbook of Automobile Engineering – Vol. I , II and III”, S.K.Kataria and Sons, 2nd Edition, 2012
2. Giri, N.K., “Automotive Technology”, Khanna Publishers, 2ndEdition, 2002
3. Kirpal Singh, Automobile Engineering Volume I and II, Standard Publishers &Distributors, 14th Edition, 2017.
4. Kumar D.S., “Automobile Engineering”, S.K.Kataria and Sons, 2nd Edition, 2017.
5. Robert Bosch GmbH, “Automotive Handbook”, Robert Bosch, 2004.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2	-	-	3	-	-	-	-	-	-	2	-	3
CO 2	3	2	-	-	3	-	-	-	-	-	-	2	-	3
CO 3	3	2	-	-	3	-	-	-	-	-	-	2	-	3
CO 4	3	2	-	-	3	-	-	-	-	-	-	2	-	3
CO 5	3	2	-	-	3	-	-	-	-	-	-	2	-	3
	3	**High**				**2**	**Medium**					**1**	**Low**	

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	20	20	20	40
Apply	20	20	20	40
Analyze				
Evaluate				
Create				

20MEO04	ALTERNATE ENERGY SOURCES	L	T	P	C
		3	0	0	3
Nature of Course	**OPEN ELECTIVE COURSE**				
Pre requisites	**NIL**				

Course Objectives

The course is intended to

1. Get exposure on solar radiation and its environmental impact to power
2. Understand role significance of solar energy and various collectors used for storing solar energy.
3. Learn about the wind energy and biomass and its economic aspects
4. Understand the role of geothermal energy and ocean energy in the Energy Generation
5. Understand the concept of energy Conservation

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Recall the basic concepts of solar energy, measurement of solar radiation, solar thermal collector and its performance.	Remember
CO 2	Explain the principle of photovoltaic energy conversion and thermal energy storage system.	Understand
CO 3	Summarize the principle of wind energy conversion and various biomass energy conversion methods.	Understand
CO 4	Demonstrate the principle of geothermal energy conversion and various ocean energy conversion technologies.	Understand
CO 5	Identify the principle of different direct energy conversion technologies.	Apply

Course Contents

Unit – I PRINCIPLES OF SOLAR RADIATION **9**

The solar energy , Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, , Instruments for measuring solar radiation and sun shine. Solar energy collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

Unit – II SOLAR ENERGY STORAGE AND APPLICATIONS **9**

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.; behavior of solar cells; cell properties;

Unit – III WIND ENERGY & BIO –MASS **9**

Sources and potentials, horizontal and vertical axis windmill, process of electricity generation and wind farms. BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters.

Unit – IV GEOTHERMAL & OCEAN ENERGY **9**

Resources, types of wells, methods of harnessing the energy, potential in India. Ocean energy: OTEC, Principles utilization, setting of OTEC plants. Tidal and wave energy: Potential and conversion techniques.

Unit – V ALTERNATE FUELS **9**

Estimation of petroleum reserve - Need for alternate fuel - Availability and properties of alternate fuels - general use of alcohols - LPG - Hydrogen - Ammonia, CNG, and LNG - Vegetable oils and Biogas - Merits and demerits of various alternate fuels.

Total : 45 Periods

Passed in Board of Studies Meeting on 25.02.2022 *Passed in Academic Council Meeting on 09.03.2022*

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

Text Books

1. S.Rao, Non-conventional, renewable and conventional energy, Khanna Publishers ,New Delhi, 2005
2. Boyle, G. Renewable energy, Power for a sustainable future. Oxford University press, Oxford, UK, 2004.

Reference Books

1. John Twidell & Tony Weir, Renewable Energy resources, Routledge, 2015
2. Kemp, W.H. The Renewable Energy Handbook, Aztext Press Ontario, Canada, 2009 3.Duffie, J. A. & W. A. Beckman, Solar Engineering of Thermal Processes, 3rd ed. John Wiley & Sons, Inc. 2006.
3. Demirbas, A. Biorefineries – for biomass upgrading facilities, Springerpublishers, 2010.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3		-	-		-	2	-	-	-	-	2	-	2
CO 2	3		-	-		-	2	-	-	-	-	2	-	2
CO 3	3		-	-		-	2	-	-	-	-	2	-	2
CO 4	3		-	-		-	2	-	-	-	-	2	-	2
CO 5	3		-	-		-	2	-	-	-	-	2	-	2
	3	**High**				**2**	**Medium**					**1**	**Low**	

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

Passed in Board of Studies Meeting on 25.02.2022 — CHAIRMAN - BOARD OF STUDIES

Passed in Academic Council Meeting on 09.03.2022 — CHAIRMAN - ACADEMIC COUNCIL

20MEO05	ROBOTICS	L	T	P	C
		3	0	0	3
Nature of course	**OPEN ELECTIVE COURSE**				
Pre requisites	**NIL**				

Course Objectives

The course is intended to

1. understand the functions of the basic components of a robot interpret
2. study the use of various types of End of effectors and sensors
3. impart knowledge on dynamics of robots and sensors used in robot
4. impart knowledge in robot kinematics and programming
5. learn safety issues in robot implementation and economics

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Select the robot and its grippers based on application.	Remember
CO 2	Explain the robot position and orientation	Understand
CO 3	Describe the sensing and visioning operations of robot	Understand
CO 4	Summarize optimal trajectory and path planning of robots	Understand
CO 5	Select the robot for an industry and perform economic study.	Apply

Course Contents

Unit – I FUNDAMENTALS OF ROBOT **9**

Robot - Definition - Robot Anatomy - Co-ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

Unit – II ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic-Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers.

Unit – III SENSORS AND MACHINE VISION **9**

Requirements of a sensor - Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition.

Unit – IV ROBOT KINEMATICS AND ROBOT PROGRAMMING **9**

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension). Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

Unit – V IMPLEMENTATION AND ROBOT ECONOMICS **9**

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

Total : 45 Periods

Text Books

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2009.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001

Reference Books

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2017.
3. Koren Y., “Robotics for Engineers", McGraw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
5. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.
6. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2008.
7. Surender Kumar, “Industrial Robots and Computer Integrated Manufacturing”, Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3				3							2		2
CO 2	3				3							2		2
CO 3	3				3							2		2
CO 4	3				3							2		2
CO 5	3				3							2		2
	3	**High**				**2**	**Medium**					**1**	**Low**	

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20MEO06	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3
Nature of course	**OPEN ELECTIVE COURSE**				
Pre requisites	**NIL**				

Course Objectives

The course is intended to

1. Enable the students to study the evolution of Management,
2. Study the functions and principles of management.
3. Learn the application of the principles in an organization.
4. Enable the effective and barriers communication in the organization
5. Study the system and process of effective controlling in the organization..

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Recall an understanding of basic management concepts, principles, and practices.	Remember
CO 2	Develop strategic planning and decision-making strategies in an organization.	Apply
CO 3	Summarize the concept and complete the process of organizing.	Understand
CO 4	Interpret an understanding of staffing, leadership, and motivation in an organization.	Understand
CO 5	Demonstrate the dynamics of controlling and its emerging issues in management.	Understand

Course Contents

Unit – I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **9**

Definition of Management - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment.

Unit – II PLANNING **9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

Unit – III ORGANISING **9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management.

Unit – IV DIRECTING **9**

Foundations of individual and group behavior – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication.

Unit – V CONTROLLING **9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

Total : 45 Periods

Text Books

1. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.

Reference Books

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 1998.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo& Mary Coulter, “Fundamentals of Management”, 7th Edition, Pearson Education, 2011.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 19

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1						3			3					2
CO 2						3			3					2
CO 3						3			3					2
CO 4						3			3					2
CO 5						3			3					2
	3	High				2	Medium					1	Low	

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
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Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

B.E. Mechanical Engineering

REGULATION 2023

CURRICULUM AND SYLLABI

I to IV SEMESTER

ENGINEERING COLLEGE

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KOMARAPALAYAM - 637303

B.E. MECHANICAL ENGINEERING
REGULATION – 2023
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULUM

I SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23MA102	Matrices and Calculus	BS	3	1	0	4	40	60	100
23EE103	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	40	60	100
23ME102	Fundamentals of Mechanical Engineering	ES	3	0	0	3	40	60	100
23LET07	Heritage of Tamils (தமிழர்மரபு)	HSS	1	0	0	1	100	0	100
Theory with Practical Course(s)									
23LEEXX	Language Elective - I	HSS	2	0	2	3	50	50	100
23CH102	Chemistry for Materials Science	BS	3	0	2	4	50	50	100
23ME101	Engineering Graphics	ES	1	0	4	3	50	50	100
Mandatory Course- I									
23MC101	Induction Programme	MC	2 Weeks			0	100	0	100
TOTAL			**16**	**1**	**8**	**21**	**370**	**330**	**700**

Language Electives – I									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
23ENE01	Communicative English	HSS	2	0	2	3	50	50	100
23LEE02	Advanced Communicative English	HSS	2	0	2	3	50	50	100

Passed in Board of Studies

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II SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
23MA202	Mathematical Foundation for Engineering	BS	3	2	0	4	40	60	100
23ME201	Engineering Mechanics	ES	3	2	0	4	40	60	100
23LET08	Tamils & Technology (தமிழரும் தொழில்நுட்பமும்)	HSS	1	0	0	1	100	0	100
Theory with Practical Course(s)									
23LEXXX	Language Elective - II	HSS	2	0	2	3	50	50	100
23PH202	Material Physics	BS	3	0	2	4	50	50	100
23CS203	Problem Solving using Python Programming	ES	3	0	2	4	50	50	100
Practical Course(s)									
23ME202	Mechanical Engineering Practices Laboratory	ES	0	0	2	1	60	40	100
Mandatory Course									
23MCXXX	Mandatory course -II	MC	2	0	0	0	100	-	100
Total			**17**	**4**	**8**	**21**	**490**	**310**	**800**

Language Electives – II									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
23LEE02	Advanced Communicative English	HSS	2	0	2	3	50	50	100
23LEH03	Hindi	HSS	2	0	2	3	50	50	100
23LEF04	French	HSS	2	0	2	3	50	50	100
23LEG05	German	HSS	2	0	2	3	50	50	100
23LEJ06	Japanese	HSS	2	0	2	3	50	50	100

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III SEMESTER									
Code No.	**Course**	**Category**	**Periods /Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23ME301	Engineering Thermodynamics	PC	3	1	0	4	40	60	100
23ME302	Engineering Materials and Metallurgy	PC	3	0	0	3	40	60	100
23ME303	Fluid Mechanics and Machinery	PC	3	0	0	3	40	60	100
23UH001	Universal Human Values	HSS	3	0	0	3	100	0	100
Theory with Practical Course(s)									
23MA301	Transforms and Boundary Value Problems	BS	3	2	0	4	50	50	100
23ME304	Manufacturing Technology - I	PC	3	0	2	4	50	50	100
Practical Course(s)									
23ME305	Computer Aided Machine Drawing Laboratory	PC	0	0	2	1	60	40	100
23ME306	Strength of materials and Fluid Mechanics laboratory	PC	0	0	2	1	60	40	100
Mandatory Course									
23MCXXX	Mandatory Course - III	MC	2	0	0	0	100	-	100
Knowledge Demonstration- I		KD	0	0	2	0	10% Total Semester marks		
TOTAL			**20**	**3**	**8**	**23**	**540**	**360**	**900**

Passed in Board of Studies

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IV SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23ME401	Strength of Materials	ES	3	0	0	3	40	60	100
23ME402	Thermal Engineering	PC	3	0	0	3	40	60	100
23ME403	Manufacturing Technology – II	PC	3	0	0	3	40	60	100
23EE409	Electrical Drives and Controls	ES	3	0	0	3	40	60	100
Theory with Practical Course(s)									
23MA402	Statistics and Numerical Methods	BS	3	2	0	4	50	50	100
23ME404	Engineering Metrology	PC	3	0	2	4	50	50	100
Practical Course(s)									
23ME405	Thermal Engineering Laboratory	PC	0	0	2	1	60	40	100
23ME406	Manufacturing Technology Laboratory – II	PC	0	0	2	1	60	40	100
Mandatory Course									
23MCXXX	Mandatory Course -IV	MC	2	0	0	0	100	-	100
Knowledge Demonstration- II		KD	0	0	2	0	10% Total Semester marks		
Total			**20**	**2**	**8**	**22**	**490**	**410**	**900**

Passed in Board of Studies

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V SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
23ME501	Design of Machine Elements	PC	4	2	0	4	40	60	100
23ME502	Heat and Mass Transfer	PC	3	0	0	3	40	60	100
23ME503	Computer Aided Manufacturing	PC	3	0	0	3	40	60	100
23MEEXX	Professional Elective - I	PE	3	0	0	3	40	60	100
23YYOXX	Open Elective - I	OE	3	0	0	3	40	60	100
Theory with Practical Course(s)									
23ME504	Dynamics of Machinery	PC	3	0	2	4	50	50	100
Practical Course(s)									
23ME505	Heat Transfer Laboratory	PC	0	0	2	1	60	40	100
23ME506	Computer Aided Manufacturing Laboratory	PC	0	0	2	1	60	40	100
Mandatory Course									
23MCXXX	Mandatory Course -V	MC	2	0	0	0	100	-	100
Knowledge Demonstration- III		KD	0	0	2	0	10% Total Semester marks		
TOTAL			**21**	**2**	**8**	**22**	**470**	**430**	**900**

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VI SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
23ME601	Design of Transmission System	PC	3	2	0	4	40	60	100
23ME602	Finite Element Analysis	PC	3	0	0	3	40	60	100
23MEEXX	Professional Elective - II	PE	3	0	0	3	40	60	100
23YYOXX	Open Elective - II	OE	3	0	0	3	40	60	100
Theory with Practical Course(s)									
23ME603	Mechatronics Engineering	PC	3	0	2	4	50	50	100
Practical Course(s)									
23ME604	Modeling Laboratory	PC	0	0	4	2	60	40	100
23ME605	Design Thinking & Mini Project	EEC	1	0	2	2	60	40	100
23ME606	Internship	EEC	Two Weeks			1	100	0	100
Knowledge Demonstration- IV		KD	0	0	2	0	10% Total Semester marks		
Total			**16**	**2**	**10**	**22**	**430**	**370**	**800**

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VII SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23ME701	Entrepreneurship and Professional Ethics	PC	3	0	0	3	40	60	100
23ME702	Total Quality Management	HSS	3	0	0	3	40	60	100
23MEEXX	Professional Elective - III	PE	3	0	0	3	40	60	100
23MEEXX	Professional Elective - IV	PE	3	0	0	3	40	60	100
23MEEXX	Professional Elective - IV	PE	3	0	0	3	40	60	100
23YYOXX	Open Elective - III	OE	3	0	0	3	40	60	100
Practical Course(s)									
23ME704	Simulation and Analysis Laboratory	PC	0	0	2	1	60	40	100
23ME705	Design Project	EEC	0	0	2	1	60	40	100
Knowledge Demonstration- V		KD	0	0	2	0	10% Total Semester marks		
TOTAL			**18**	**0**	**6**	**20**	**320**	**380**	**700**

VIII SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
23MEEXX	Professional Elective - V	PE	3	0	0	3	40	60	100
23MEEXX	Professional Elective - VI	PE	3	0	0	3	40	60	100
23ME801	Major Project	EEC	0	0	16	8	50	50	100
Total			**6**	**0**	**16**	**14**	**130**	**170**	**300**

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MANDATORY COURSES (MC)									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
23MEEXX	Induction Programme	MC	2 Weeks			0	100	-	100
23MEEXX	Environmental Sciences	MC	2	0	0	0	100	-	100
23MEEXX	Interpersonal Skills	MC	2	0	0	0	100	-	100
23MEEXX	Indian Constitution	MC	2	0	0	0	100	-	100
23MEEXX	Yoga and Values for Holistic Development	MC	2	0	0	0	100	-	100

PROFESSIONAL ELECTIVES (PE)									
Stream – I Design Engineering									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
23MEE01	Design Thinking	PE	3	0	0	3	40	60	100
23MEE02	Product Design	PE	3	0	0	3	40	60	100
23MEE03	Tool and Die Design	PE	3	0	0	3	40	60	100
23MEE04	Design of Hydraulic and Pneumatic Systems	PE	3	0	0	3	40	60	100
23MEE05	Design for Manufacturing and Assembly	PE	3	0	0	3	40	60	100
23MEE06	Optimization Techniques in Engineering Design	PE	3	0	0	3	40	60	100
23MEE07	Computational Fluid Dynamics	PE	3	0	0	3	40	60	100
23MEE08	Engineering Tribology	PE	3	0	0	3	40	60	100
23MEE09	Mechanical Vibrations	PE	3	0	0	3	40	60	100
23MEE10	Design of pressure vessels	PE	3	0	0	3	40	60	100
23MEE61	Automobile Engineering	PE	3	0	0	3	40	60	100
23MEE62	Automotive transmission systems	PE	3	0	0	3	40	60	100
23MEE63	Vehicle body engineering	PE	3	0	0	3	40	60	100
Stream – II Thermal Engineering									
23MEE21	Non-Conventional Energy Sources	PE	3	0	0	3	40	60	100
23MEE22	Power Plant Engineering	PE	3	0	0	3	40	60	100

23MEE23	Refrigeration and Air Conditioning	PE	3	0	0	3	40	60	100
23MEE24	Turbo Machines	PE	3	0	0	3	40	60	100
23MEE25	Gas Dynamics and Jet Propulsion	PE	3	0	0	3	40	60	100
23MEE26	Internal Combustion Engines	PE	3	0	0	3	40	60	100
23MEE27	Cryogenic Engineering	PE	3	0	0	3	40	60	100
23MEE28	Design of Heat exchangers	PE	3	0	0	3	40	60	100
23MEE29	Refrigerants	PE	3	0	0	3	40	60	100
23MEE30	Gas turbines	PE	3	0	0	3	40	60	100
23MEE64	Alternate fuels for automobiles	PE	3	0	0	3	40	60	100
23MEE65	Automotive emission and control	PE	3	0	0	3	40	60	100
23MEE68	Electric and hybrid vehicles	PE	3	0	0	3	40	60	100
Stream – III Manufacturing Engineering									
23MEE41	Additive Manufacturing	PE	3	0	0	3	40	60	100
23MEE42	Industrial Automation	PE	3	0	0	3	40	60	100
23MEE43	Modern Manufacturing Processes	PE	3	0	0	3	40	60	100
23MEE44	Industrial Robotics	PE	3	0	0	3	40	60	100
23MEE45	Advanced casting techniques	PE	3	0	0	3	40	60	100
23MEE46	Advanced welding techniques	PE	3	0	0	3	40	60	100
23MEE47	Process Planning and cost estimation	PE	3	0	0	3	40	60	100
23MEE48	Operations Research	PE	3	0	0	3	40	60	100
23MEE49	Manufacturing of composite materials	PE	3	0	0	3	40	60	100
23MEE50	CNC Machine tools	PE	3	0	0	3	40	60	100
23MEE51	Supply chain management	PE	3	0	0	3	40	60	100
23MEE66	Two and three wheelers	PE	3	0	0	3	40	60	100
23MEE67	Off road vehicles	PE	3	0	0	3	40	60	100
23MEE69	Vehicle maintenance	PE	3	0	0	3	40	60	100
23MEE70	Smart mobility	PE	3	0	0	3	40	60	100

OPEN ELECTIVE COURSES (For Other Branches)									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
23MEO01	Integrated Product Development	OE	3	0	0	3	40	60	100
23MEO02	Manufacturing processes	OE	3	0	0	3	40	60	100
23MEO03	Automotive Technology	OE	3	0	0	3	40	60	100
23MEO04	Alternate energy sources	OE	3	0	0	3	40	60	100
23MEO05	Robotics	OE	3	0	0	3	40	60	100
23MEO06	Principles of management	OE	3	0	0	3	40	60	100
23MEO07	Industrial Automation	OE	3	0	0	3	40	60	100
23MEO08	Machine Learning	OE	3	0	0	3	40	60	100
23MEO09	Autotronics	OE	3	0	0	3	40	60	100
23MEO10	Thermal Management systems	OE	3	0	0	3	40	60	100

ONE CREDIT COURSES									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
23MEA01	Lean Manufacturing	EEC	1	0	0	1	100	0	100
23MEA02	Internet of things	EEC	1	0	0	1	100	0	100
23MEA03	Plastics - Processing, Tooling, Assembly and Testing	EEC	1	0	0	1	100	0	100
23MEA04	Automotive Electronics	EEC	1	0	0	1	100	0	100
23MEA05	CNC Programming	EEC	1	0	0	1	100	0	100
23MEA06	PLC Programming	EEC	1	0	0	1	100	0	100
23MEA07	Vehicle testing and certification	EEC	1	0	0	1	100	0	100
23MEA08	Welding technology	EEC	1	0	0	1	100	0	100
23MEA09	Casting engineering	EEC	1	0	0	1	100	0	100
23MEA10	Fuel Cell technology	EEC	1	0	0	1	100	0	100

Knowledge Demonstration

To evaluate the acquired knowledge in the courses learnt during each semester (from III semester to VII semester only) the students are made to demonstrate through Seminar, Project, Prototype, Design Ideas and Poster Presentation (any one mode). The skill demonstrated by the students will be evaluated by the external examiners for 10% of total semester marks. The marks obtained by the students out of the 10% of total semester marks will be distributed across the courses of that particular semester. The knowledge demonstration component will be evaluated from III semester to VII semester.

To accommodate the knowledge demonstration mark that need to be distributed, the maximum course marks (100) is converted for 90.

$$Course\ Marks = 90\%\ of\ the\ marks\ scored\ by\ the\ students\ including\ internal\ and\ External + \frac{10\%\ of\ the\ Total\ semester\ Marks}{Total\ No\ of\ Courses}$$

(Whereas Knowledge Demonstration Marks = 10% of the total Semester marks)

Final Viva-Voce Examination (100)		**Total**
Internal	External	100
20	80	

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CREDIT SUMMARY

S. No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDITS (AICTE)	CREDITS in %
		I	II	III	IV	V	VI	VII	VIII		
1.	HSS	4	4	3				3		14 (10-14)	8.48
2.	BS	8	8	4	4					24 (22-28)	14.55
3.	ES	9	9		6					24 (24)	14.55
4.	PC			16	12	16	13	4		61 (48)	36.96
5.	PE					3	3	9	6	21 (18)	12.73
6.	OE					3	3	3		9	5.45
7.	EEC						3	1	8	12 (12-16)	7.27
8.	MC	0	0	0	0	0	0	0	0	0	0.00
Total		21	21	23	22	22	22	20	14	165	100%

HSS - Humanities and Social Sciences

BS - Basic Sciences

ES - Engineering Sciences

PC - Professional Core

PE - Professional Electives

OE - Open Electives

EEC - Employability Enhancement Courses

MC - Mandatory Courses (Non-Credit Courses)

CA - Continuous Assessment

FE - Final Examination

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23MA102	MATRICES AND CALCULUS (Common to all B.E/B.Tech Programmes)	L	T	P	C
		3	1	0	4
Nature of Course	Basic Sciences				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Introduce the concept of orthogonal transformation to convert the square matrix into diagonal form.
2. Acquaint the student with mathematical tools needed in evaluating derivatives and differentiation of one variable.
3. Familiarize the functions of two variables, Taylor series and Jacobian techniques
4. Impart knowledge of double integral techniques in evaluating volume of the solid.
5. Learn the Green's theorem Stoke's theorem and the Divergence theorem to compute integrals

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Apply the concept of orthogonal reduction for diagonalization of the given matrix	Apply
CO 2	Execute the rules of differentiation to differentiate the functions.	Apply
CO 3	Demonstrate the maxima and minima for a given function with two variables	Apply
CO 4	Apply integration to compute area and volume using multiple integrals	Apply
CO 5	Interpret the Green's theorem, Stokes' theorem and Divergence theorem to evaluate integrals.	Apply

Course Contents

Module – I MATRICES 9+3

Eigen values and Eigenvectors of a real matrix – Characteristic Equation- Properties - Cayley Hamilton Theorem - Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic Forms.

Module – II DIFFERENTIAL CALCULUS 9+3

Functions of single Variable -Limits and Continuity - Derivatives - Differentiation rules(sum, product, quotient, chain rule) – Implicit differentiation-Logarithmic differentiation-Maxima and Minima of function of one variable –Taylors series.

Module – III FUNCTIONS OF TWO VARIABLES 9+3

Limits and Continuity –Partial differentiation–Homogeneous functions and Euler's theorem– Jacobians –Partial differentiation of implicit functions–Taylor's series– Maxima and minima – Lagrange s method of multipliers.

Module – IV **MULTIPLE INTEGRALS** 9+3

Double integrals – Change of order of integrations- Double integrals in polar coordinates – Areaenclosed by plane curves – Triple integrals – Volume of solids.

Module – V **VECTOR CALCULUS** 9+3

Gradient and directional derivative — Divergence and curl — Green's, Gauss divergence and Stoke's theorems — Verification andapplicationinevaluatingline, surfaceandvolumeintegrals (cube, rectangular parallelepiped)

Total : 60 Periods

Text Books

1. B.K.Pal and K.Das , "Engineering Mathematics", Volume-1, 10th Edition, U.N.Dhur and Sons private limited,2020
2. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, Delhi, 44th Edition. 2019

Reference Books

1 Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company. 1st Edition, 2018
2 N.P.Bali, Manish Goyal, "A text book of Engineering Mathematics Semester II", Laxmi Publications, 6th Edition 2015.
3. Veerarajan T," Engineering Mathematics for Semester I and II", Tata McGraw Hill. 3rd Edition 2017.

Additional References

1 NPTEL-https://nptel.ac.in/courses/111105035
2. NPTEL-https://nptel.ac.in/courses/111104144
3 NPTEL- https://nptel.ac.in/courses/111105122

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	2										1	
CO 2	3	3	2										1	
CO 3	3	1	1										1	
CO 4	3	2	1										1	
CO 5	3	2	2										1	
	3-High				2-Medium				1-Low					

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Passed in Board of Studies Meeting 17.03.23 *Passed in Academic Council Meeting 27.04.23*

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyse				
Evaluate				
Create				

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Passed in Board of Studies Meeting 17.03.23 *Passed in Academic Council Meeting 27.04.23*

23EE103	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING (Common to Aero, Mech, SFE)	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Engineering Science				

Course Objectives

The course is intended to

1. Learn the basic concepts of electrical elements and measuring instruments.
2. Introduce the basics of electric circuits and analysis
3. Impart knowledge in the basics of working principles and application of electrical machines.
4. Identify the analog devices and their characteristics
5. Educate on the fundamental concepts of digital electronics.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Express the operating principles of electrical elements and measuring instruments	Understand
CO 2	Compute the electric circuit parameters for simple problems.	Apply
CO 3	Examine the working principle and applications of electrical machines	Understand
CO 4	Explain the characteristics of analog electronic devices	Understand
CO 5	Discuss the basic concepts of digital electronics	Understand

Course Contents

Module – I	ELECTRICAL ELEMENTS AND MEASURING INSTRUMENTS	9
Resistance, Inductance, Capacitance, Wires and Cables Ammeter, Voltmeter, Wattmeter, Energymeter, Thermistor and Anemometer		
Module – II	**ELECTRICAL CIRCUITS**	9
Ohm's Law, Kirchhoff's Laws, Mesh and Nodal analysis, Introduction to AC Circuits, Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor.		
Module – III	**ELECTRICAL MACHINES**	9
Construction and operating characteristics: DC Motor, DC Generator, Single Phase Transformer, Three phase Induction motor, Three phase Alternator, Synchronous Motor.		
Module – IV	**ANALOG ELECTRONICS**	9
Semiconductor Materials: Silicon &Germanium ,Construction and operating characteristics of PN Junction Diodes, Zener Diode , Half wave and Full wave Rectifiers , Bipolar Junction Transistor ,CB, CE, CC Configurations and Characteristics.		

Passed in Board of Studies Meeting (12-04-2023)

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Approved in Academic Council Meeting (26-04-2023)

Module – V	**DIGITAL ELECTRONICS**	9
Number System ,Logic Gates ,Boolean algebra ,Adders, Subtractors, SOP and POS forms, K-map representations, minimization using K maps (Simple Problems only)		
		Total : 45 Periods

Text Books

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2. S.K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

Reference Books

1. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017.
3. Mahmood Nahvi. and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
4. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

Additional References

1. **NPTEL** - https://nptel.ac.in/courses/108105017
2. **NPTEL** -https://onlinecourses.nptel.ac.in/noc21_ee55/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2	1	1										1	1
CO 2	3	2	1										1	1
CO 3	2	1	1										2	1
CO 4	2	1	1										2	1
CO 5	2	1	1										2	1
	3-High				2-Medium				1-Low					

Passed in Board of Studies Meeting (12-04-2023)

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Approved in Academic Council Meeting (26-04-2023)

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	10	10	10	20
Understand	40	20	30	60
Apply		20	10	20
Analyse				
Evaluate				
Create				

Passed in Board of Studies Meeting (12-04-2023)

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Approved in Academic Council Meeting (26-04-2023)

23ME102	Fundamentals of Mechanical Engineering	L	T	P	C
		3	0	0	3
Nature of Course	**Engineering Sciences**				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Impart knowledge of mechanical engineering fundamentals of application.
2. Gain knowledge of mechanical process and their applications.
3. Learn the principles of power plant engineering with suitable properties.
4. Develop a clear understanding about internal combustion engines.
5. Explore the knowledge on thermodynamics for refrigeration cycles

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Summarize the metal casting process.	Understand
CO2	The joining process of metal to arc, electrode and gas welding Process	Understand
CO3	Compare the properties of water tube and tube boilers	Understand
CO4	Infer and compare the performance of I.C engines	Understand
CO5	Contrast the refrigeration and air conditioning systems	Understand

Course Contents

Module I Metal Casting Process **9**

Manufacturing Process: Casting, pattern, pattern materials, types, allowances, molding tools, preparation of green sand mould, and manufacturing of cast iron, Cupola furnace, and operation, casting defects, causes and remedies.

Module II Metal Joining Process **9**

Arc welding**,** Arc welding equipment, electrode, welding process, defects in welding Gas welding, equipment

Module III Power Plant Engineering **9**

Thermal systems: Introduction, Classification of Power Plants, Working principle of steam, fire tube and water tube boilers

Module IV Internal Combustion Engines **9**

Internal combustion engines as automobile power plant, working principle of Petrol and Diesel Engines, Four stroke and two stroke cycles, Comparison of four stroke and two stroke engines

Module V Refrigeration and Air Conditioning Systems **9**

Terminology of Refrigeration and Air Conditioning, Principle of vapor compression refrigeration system, Layout of typical domestic refrigerator, Window and Split type room Air conditioner

Total: 45 Periods

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Text Books

1. Shanmugam G. , Palanichamy M.S., “Basic Civil and Mechanical Engineering”, McGraw Hill Education, 2018.
2. Hajra Choudhury, “Elements of Workshop Technology, Vol. I and II”, Media Promotors Pvt Ltd., Mumbai, 2010.
3. Rao P.N., ”Manufacturing Technology”, Tata McGraw-Hill Publishing Limited, II Edition, 2018

Reference Books

1. Magendran Parashar B.S. and Mittal R.K.”Elements of Manufacturing Processes”, Prentice Hall of India, 2003.
2. Gowri S., Hariharan P. and Suresh Babu A., “Manufacturing Technology 1”, Pearson Education , 2008.
3. Sharma, P.C., “A text book of Production Technology”, Chand, S and Company, IV Edition, 2003.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2										1		
CO2	3	3	2										1		
CO3	3	3	2										1		
CO4	3	3	2										1		
CO5	3	3	2										1		
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Understand	Direct Measures : Quiz / Presentation/Tutorial	5	15
Understand	Indirect measures : Assignment/Video presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Exams**			**Final Examination (60)**
	IAE 1 (5)	**IAE 2 (10)**	**IAE 3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

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23LET07 **தமிழர் மரபு** LTPC 1 0 0 1

அலகு I **மொழி மற்றும் இலக்கியம்:** 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II **மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை:** 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV **தமிழர்களின் திணைக் கோட்பாடுகள்:** 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:** 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

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REFERENCE BOOKS

1. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
2. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (In print)
3. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
4. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
5. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

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1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books

TOTAL : 15 PERIODS

TEXT BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

REFERENCE BOOKS

1. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
2. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
3. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
4. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
5. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

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23LEE01	COMMUNICATIVE ENGLISH Common to all B.E./B.Tech Programmes	L	T	P	C
		2	0	2	3
Nature of Course	Humanities and Sciences				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Improve lexical, grammatical and semantic competence.
2. Enhance communicative skills in real life situations.
3. Augment thinking in all forms of communication.
4. Equip with oral and written communication skills.
5. Gain employability skills.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Use effectively the lexical, grammatical and semantic knowledge	Understand
CO2.	Communicate with clarity using intentional vocabulary in English	Apply
CO3.	Articulate perfectly and express their opinions confidently	Apply
CO4.	Accomplish listening and reading skills for life long learning	Apply
CO5.	Comprehend, interpret and present data	Understand

Course Contents:

MODULE I BASIC GRAMMAR AND USAGE 9

Grammar: Parts of Speech – Verb (Primary & Modal Auxiliary) – Prefixes and Suffixes **Listening:** Listening Skills: Importance and Types of Listening – Barriers of Listening - Listening to short monologues **Speaking:** Introducing oneself – Role play **Reading:** Types of Reading – Intensive reading – Extensive Reading – Reading Comprehension **Writing:** Permission letter (Industrial Visit) – Informal letter – Dialogue writing

MODULE II APPLICATIONS OF LANGUAGE SKILLS 9

Grammar: Tenses (Present, Past and Future) – Different Forms of a word – Types of Questions **Listening:** Listening strategies – Listening to Announcements **Speaking:** Likes and dislikes- Movie Reviews – **Reading:** Skimming - Scanning - Reading Newspaper and Articles **Writing:** Inviting Dignitaries – Accepting Invitation – Declining Invitation.

MODULE III CONVERSATIONAL SKILLS 9

Grammar: If conditionals – Numerical Adjectives **Listening:** - Listening to Telephone calls and taking notes – Listening Lectures **Speaking:** Technical Presentation – Group Discussion **Reading:** Reading Magazines - Cloze Test **Writing:** Calling for Quotation – Complaint Letter – Process Description

MODULE IV GRAMMATICAL ACCURACY COMPETENCE 9

Grammar: Subject verb agreement – Discourse markers - One word substitution **Listening:** Listening and gap filling – Listening and Match the answers **Speaking:** Narrating Story - Asking and giving directions **Reading:** Rearranging Jumbled sentence - Note making **Writing:** Instructions – Hints Developing – Report Writing (Fire and Accident Report)

Passed in Board of Studies Meeting on 17.03.23 ***Passed in Academic Council Meeting on 27.04.23***

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MODULE V TECHNICAL WRITING SKILLS 9

Grammar: Homophones and Homonyms - Abbreviation and Acronyms **Listening:** Listening announcements – Listening and Summing up **Speaking:** Impromptu speech – Presentation at a business meeting **Reading:** Reading and summarizing articles **Writing:** Paragraph Writing – Checklist – Story writing.

Total: 45 Periods

Laboratory Components

S.No.	List of Exercises	CO Mapping	RBT
1	Self Introduction	1	Understand
2	Movie Review	2	Apply
3	Group Discussion	3	Apply
4	Asking and Giving Directions	4	Apply
5	Impromptu Speech	5	Apply
6	Listening to short monologues	1	Understand
7	Listening to Announcement	2	Understand
8	Listening Telephone calls	3	Understand
9	Listening and Gap Filling	4	Apply
10	Listening and Match the answers	4	Apply

Text Books

1. Rizvi, Ashraf.M, "Effective Technical Communication",Tata McGraw Hill Publishing company Limited,New Delhi, 2nd Edition, 2018.
2. Hewings. M, "Advanced English Grammar", 3rd Edition, Cambridge University Press, Chennai, 9th Edition, 2019.
3. Board of Editors, "Using English – A Course book for Undergraduate Engineers and Technologists", Orient Black Swan Private Limited, Hyderabad, 3rd Edition, 2019.

Reference Books:

1. Raman M & Sangeetha Sharma, "Technical Communication", Oxford University Press,USA,13thEdition,2018.
2. Norman Whitby, Business Benchmark – "Pre-Intermediate to Intermediate, Students Book", Cambridge University Press, 1st Edition, 2006.
3. Dhanavel S. P., "English and Soft Skills", 1stEdition, Orient Black Swan Private Limited, Hyderabad, 1st Edition, 2010.

Web References:

1. https://www.englishclub.com/grammar/
2. https://learnenglish.britishcouncil.org
3. https://www.indiabix.com/verbal-ability/questions-and-answers/
4. https://www.elllo.org
5. https://englishforeveryone.org/Topics/Reading-Comprehension.html

RMAN - BOARD O

Passed in Board of Studies Meeting on 17.03.23 *Passed in Academic Council Meeting on 27.04.23*

23CH102	CHEMISTRY FOR MATERIALS SCIENCE (Common to AERO, AGRI, CIVIL, MECH, PCT and SF)	L	T	P	C
		3	0	2	4
Nature of Course	Basic Sciences				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Impart knowledge and understanding about the constituents present in water and the need for purification of water.
2. Provide knowledge about the basic principles, preparatory methods and applications of nanomaterials.
3. Understand the causes and control measures of corrosion.
4. Learn about the nature, types of the soil and suitable fertilizers for different types of soil.
5. Gain knowledge about fuels and calorific value of solid fuel, liquid fuel and gaseous fuel.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Develop innovative and eco-friendly method for water purification to meet the growing industrial demand.	Apply
CO 2	Discuss the basic principles, synthesis and applications of nanomaterials	Understand
CO 3	Demonstrate the importance of protection of metals from corrosion.	Understand
CO 4	Identify the nature of the soil and to decide fertilizer for a particular soil depending on its nature	Understand
CO 5	Classify fuels based on their efficiency of combustion.	Apply

Course Contents

Module – I WATER ANALYSIS AND WATER TREATMENT 9

Water analysis: Sources of water, hard water and soft water, Hardness of water, acidity, alkalinity, pH value. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD). Water treatment: Definition, Zeolite process, Conditioning methods: internal conditioning (Phosphate, Calgon) and external conditioning (Demineralization). Desalination, Reverse-osmosis (RO).

Module – II NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials. Size-dependent properties, Types of nanomaterials: Definition, properties, and uses of nanoparticle, nanocluster, nanorod, nanowire and nanotube. Synthesis: Sol-Gel and laser ablation methods. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

Module – III CORROSION AND ITS CONTROL 9

Corrosion: Classification, Types: Chemical corrosion and Electrochemical corrosion. Corrosion control: Corrosion Inhibitors, cathodic protection (sacrificial anodic protection, impressed current cathodic protection), Protective coating, Paint and Electroplating.

Passed in Board of Studies Meeting on 17.03.2023 Passed in Academic Council Meeting on 27.04.2023

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Module – IV SOIL CHEMISTRY& FERTILIZER 9

Types of soil: saline soil, acidic soil and alkaline soil, submerged soil, salt affected and calcareous soil. Characteristics and Reclamation. Effect of N, P, K, Secondary nutrients and micronutrients on plant growth and development. Importance of nitrogenous fertilizers. Green manuring- definition and examples.

Module – V FUELS AND COMBUSTION 9

Solid fuel: Coaland its varieties, analysis of coal: proximate and ultimate with their significance. Manufacture of metallurgical coke (Otto-Hoffmann method).Liquid fuel: petroleum oil. Knocking: octane number. Diesel: cetane number. Gaseous fuels - Water gas and Liquefied Petroleum Gas. Combustion: Introduction, Calorific value- Gross and net calorific value, Dulong's formula and problems.

Total : 45 Periods

Laboratory Component

S.No.	Name of the Experiment	CO Mapping	RBT
1	Determination of hardness of water.	3	Apply
2	Determination of chloride content in water sample.	3	Apply
3	Conductometric titration of strong acid versus strong base.	3	Apply
4	Determination of strength of HCl by pH metry.	3	Apply
5	Estimation of copper in brass by EDTA method.	3	Apply
6	Determination of rate of corrosion by weight loss method	3	Apply
7	Estimation of strength of iron by potentiometric titration	3	Apply
8	Determination of strength of acids in a mixture of acids using conductivity meter	3	Apply

Total Periods: 30

Text Books

1. Dr. A. Ravikrishnan, "Engineering Chemistry" Sri Krishna Hitech Publishing Company, Chemistry, 2021.
2. N. Krishnamurthy, "Engineering Chemistry" PHI Learning, 4th Edition, 2020.
3. Dr.Sunita Rattan. Publisher, S.K. Kataria& Sons. Edition. Reprint, 2020

Reference Books

1. S S. Dara. "A Text Book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018
2. B.S Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
3. Murthy, V.N S. "Soil Mechanics and Foundation Engineering", UBS Publishers and Distributors, New Delhi, 2017

Additional References

1. https://nptel.ac.in/downloads/122101001
2. https://nptel.ac.in/courses/103103033/module9/lecture1.pdf
3. https://nptel.ac.in/courses/102103044/3
4. https://www.youtube.com/watch?v=jFOeDef6bug

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Passed in Board of Studies Meeting on 17.03.2023 Passed in Academic Council Meeting on 27.04.2023

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2									1			
CO 2	3	2									1			
CO 3	3	1									1			
CO 4	3	2									1			
CO 5	3	2									1			
	3-High				2-Medium				1-Low					

Summative Assessment						
Bloom's Level	Continuous Assessment					Final Examination (Theory) [50]
	Theory				Practicals	
	IAE-I [5]	IAE-II [10]	IAE-III [10]	Attendance [5]	Rubric based CIA [20]	
Remember	20	20	20		-	30
Understand	25	25	25		40	60
Apply	5	5	5		60	10
Analyze	-	-	-		-	
Evaluate	-	-	-		-	
Create	-	-	-		-	

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Passed in Board of Studies Meeting on 17.03.2023 Passed in Academic Council Meeting on 27.04.2023

23ME101	Engineering Graphics (Common to Aeronautical, Agriculture, Civil, Mechanical, Safety and Fire Engineering & Food Technology)	L	T	P	C
		1	0	4	3
Nature of Course	Engineering Sciences				
Prerequisites	Nil				

Course Objectives:

The course is intended to

1. Understand technical drawings in various fields of engineering
2. Imagine and visualize the geometric details of engineering objects.
3. Translate the geometric information of engineering objects into engineering drawings.
4. Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings.
5. Visualize and draw isometric and perspective views

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Develop the conic sections, special curves, and draw orthographic views from pictorial views.	Apply
CO 2	Apply the principles of orthographic projections of points in all quadrants, lines and planes in first quadrant.	Apply
CO 3	Construct the projections of simple solids like prisms, pyramids, cylinder and cone.	Apply
CO 4	Build the sectional views of solids like cube, prisms, pyramids, cylinders & cones and development of its lateral surfaces.	Apply
CO 5	Organize and draw isometric view of simple solids.	Apply

Course Contents

Concepts and Conventions (Not for Examination) 1

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning.

Module -I Plane Curves and Free Hand Sketching (3+12)

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three- Dimensional objects - Layout of views- Free hand sketching of multiple views from pictorial views of objects

Module –II Projection of Lines and Plane Surface (3+12)

Orthographic projection- principles-Principal Planes-First angle projection- Projection of points - Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes

(polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

Module –III Projection of Solids (3+12)

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

Module- IV Projection of Sectioned Solids and Development of Surface (3+12)

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section, Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

Module -V Isometric Projections (3+12)

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems.

TOTAL: (15+60) Periods

TEXT BOOKS

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011
2. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Parthasarathy N S and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.

Web References

1. http://nptel.ac.in/courses/112103019/Engineering drawing
2. http://pioneer.netserv.chula.ac.th/~kjirapon/self-practice.html

Publication of Bureau of Indian Standards

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable only to Final Examinations of Engineering Graphics:

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2										1	2		
CO2	3	2										1	2		
CO3	3	2										1	2		
CO4	3	3										1	2		
CO5	3	2										1	2		
	3	High				2	Medium				1	Low			

Summative assessment						
Bloom's Level	**Continuous Assessment**					**Final Examination (Theory) [50 marks]**
	Theory				**Practical**	
	IAE-I [5]	**IAE-II [10]**	**IAE-III [10]**	**Attendance [5]**	**Rubric based CIA [20 Marks]**	
Remember	10	10	10		20	20
Understand	20	20	20		40	40
Apply	20	20	20		40	40
Analyse						
Evaluate						
Create						

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23MC101	INDUCTION PROGRAMME	L	T	P	C
		2	0	0	0
Nature of Course	Mandatory, Non Credit				
Pre requisites	Completion of Schooling at Higher Secondary Level				

Course Objectives

The course is intended to

1. To nurture the character and behavior as a student.
2. To have broad understanding of society andrelationships.
3. To impart interpersonal and softskills.
4. To inspire the students in the field ofengineering.
5. To provide exposure toindustries.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Perform curricular and co-curricular activities excellently.	Knowledge
CO 2	Do the skill based training with excellence.	Understand
CO 3	Work as team for the given task	Apply
CO 4	Gain character and behaviour	Knowledge
CO 5	Demonstrate the acquired skills effectively	Apply

Course Contents

PHYSICAL ACTIVITY

Yoga, Sports

CREATIVE ARTS (students can select any one of their choice)

Painting, sculpture, pottery, music, craft making and so on

UNIVERSAL HUMAN VALUES

Enhancing soft skills

LITERARY AND PROFICIENCY MODULES

Reading, Writing, Speaking- Debate, Role play etc., Communication and computer skills

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LECTURES BY EMINENT PEOPLE

Guest lecture by subject experts

VISIT TO LOCAL CITIES

Meditation centers / Industry

FAMILARIZATION TO DEPARTMENT / BRANCH INNOVATION

Lectures by Departments Head and senior faculty members

Total Hours: 45

Mapping of COs with POs and PSOs

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1						2	1	2				3	2		
CO2						2	1	2				3	2		
CO3						2	1	2				3	2		
CO4						2	1	2				3	2		
CO5						2	1	2				3	2		
	3	High				2	Medium					1	Low		

Bloom's Level	**Continuous Assessment (Non-Credit, Mandatory)**				
	Test -I [20]	**Test -II [20]**	**Test - III [20]**	**Assignment/ Activity [20]**	**Attendance [20]**
Remember	10	10	10		
Understand	20	20	20	10	
Apply	20	20	20	10	
Analyse					
Evaluate					
Create					

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Passed in Board of Studies Meeting 17.03.23 *Passed in Academic Council Meeting27.04.23*

23MA202	MATHEMATICAL FOUNDATIONS FOR ENGINEERING (Common to all B.E. / B.Tech Programme)	L	T	P	C
		3	1	0	4
Nature of Course	Basic Sciences				
Pre requisites	Fundamentals of Basic Mathematics				

Course Objectives

The course is intended to

1. Understand the curvature and calculate the radius of curvature, centre, evolutes, involutes.
2. Acquire the mathematical skills required to solve ordinary differential equations.
3. Familiarizethe concepts of Laplace transform and its inverse.
4. Gain knowledge of analytic approach to analyse the conformal mapping.
5. Obtainthe knowledge of evaluating contour integrals using residue theorem.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Identify the circle of curvature, evolutes and involutes of the curves.	Apply
CO2	Demonstrate various techniques to solve ordinary differential equations.	Apply
CO3	Select Laplace transform to standard functions and solve initial value problems / differential equations .	Apply
CO4	Find an analytic function ,when its real or imaginary part is known	Apply
CO5	Classify the Singularities and its corresponding Residues for the given function	Apply

Course Contents:

Module – I	APPLICATION OF DIFFERENTIAL CALCULUS	12
Curvature – Curvature in Cartesian co-ordinates - Centre and Radius of curvature- Circle of curvature- Evolutes and Involutes.		
Module – II	**ORDINARY DIFFERENTIAL EQUATION**	**12**
Higher order linear differential equations with constant coefficients – Method of variation of parameters – non-Homogenous equation - Euler and Legendre Equations.		
Module – III	**LAPLACE TRANSFORMS**	**12**
Laplace transform –Transform of elementary functions –Properties –Transforms of derivatives and integrals -Transform of periodic functions. Inverse Laplace transform –Statement and applications of Convolution theorem - Method of solving second order ordinary differential equations with constant coefficients by using Laplace transform technique.		

Module – IV	ANALYTIC FUNCTIONS	12
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates – Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping : w = a+z, az, 1/z – Bilinear transformation.		
Module – V	**COMPLEX INTEGRATION**	**12**
Line integral - Cauchy's integral theorem –Cauchy's integral formula – Taylor's and Laurent's series — Singularities — Residues — Residue theorem — Application of residue theorem for evaluation of real integrals.		
		Total: 60 Periods

Text Books:

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2019.
2. Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons (Asia) Limited, 10th Edition, 2016.

Reference Books:

1. Bali.N.P and ManishGoyal N.P, "A text book of Engineering Mathematics", Laxmi Publications, 6th Edition, 2015.
2. Ramana B.V, "Higher Engineering Mathematics",Tata McGraw Hill Publishing Company, 1st Edition, 2018.
3. Veerarajan T," Engineering Mathematics for Semester I and II", Tata McGraw Hill, 3rd Edition 2017.

Additional References:

1. https://onlinecourses.nptel.ac.in/noc24_ma12/preview
2. https://onlinecourses.swayam2.ac.in/cec24_ma10/preview
3. https://onlinecourses.nptel.ac.in/noc24_ma37/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

	Pos												PSOs		
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3												
CO2	3	3	2												
CO3	3	2	2												
CO4	3	3	3												
CO5	3	3	3												
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class /Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Exam			Final Examination (60)
	IAE I (5)	IAE II (10)	IAE III (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

23ME201	**Engineering Mechanics (Common to Mechanical, Aeronautical, Agriculture, Civil, Safety and Fire Engineering)**	**L**	**T**	**P**	**C**
		3	**2**	**0**	**4**
Nature of course	Engineering Science				
Pre requisites	Fundamentals of Physics and Mathematics				

Course Objectives

The course is intended to

1. Develop the capacity among students to predict the effect of forces and motion.
2. Make the students to understand the vector and scalar representation of forces and moment and the static equilibrium of particles.
3. Understand the effect of friction on equilibrium, laws of motion, motion kinematics and the interrelationship.
4. Make the students to understand the properties of surfaces and solids, prediction of behavior of particles and rigid bodies under the motion.
5. Make the students to familiar in laws of friction and applications of friction.

Course Outcomes

On successful completion of the course, students will be able to

COs. No.	Course Outcome	Bloom's Level
CO 1	Illustrate the Scalar and Vector representation of forces and moments.	Understanding
CO 2	Identify the Equilibrium of rigid bodies.	Apply
CO 3	Determination of properties of Surfaces and solids.	Apply
CO 4	Calculate dynamic effect of forces exerted in rigid bodies.	Apply
CO 5	Examine the laws of friction and its effects.	Apply

Course Contents

Module –I Statics of Particles **12**

Introduction - Units and Dimensions - Laws of Mechanics - Lami's theorem, Parallelogram and triangular Law of forces-Vectorial representation of forces - Vector operations of forces - additions, subtraction, dot product, cross product - Coplanar Forces - rectangular components - Equilibrium of a particle - Forces in space- Equilibrium of particle in a space - principle of transmissibility.

Module –II Equilibrium of Rigid Bodies **12**

Free body diagram - Types of supports -action and reaction forces - stable equilibrium – Moments and Couples - Moment of force about a point and an axis - Varigon's theorem - Equilibrium of Rigid bodies in two and three dimensions.

Module–III Properties of Surfaces and Solids **12**

Centroid and centre of gravity of masses - Centroid of lines and areas - Rectangular, circular, triangular areas by integration - T section, I section, - Angle section, Hollow section by using standard formula - Pappus Theorem - Parallel axis and perpendicular axis theorem -Principal moment of inertia.

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Module– IV Dynamics of Particles **12**

Displacement, Velocity and acceleration and their relationship - Relative motion - Curvilinear motion Newton's laws of motion - Work Energy Equation- lmpulse and Momentum - lmpact of elastic bodies.

Module –V Friction and Elements of Rigid Body Dynamics **12**

Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction wedge friction- Rolling resistance -Translation and Rotation of Rigid Bodies - General Plane motion of simple rigid bodies - cylinder and fly wheel dynamics.

Total : 60 Periods

Text Books

1. Rajasekaran, S. and Sankarasubramanian. G, 'Fundamentals of Engineering 17 Mechanics",Vikas Publishing House Pvl. Ltd., New Delhi, 2009.
2. Kumar, K.L., 'Engineering Mechanics", Tata McGraw-Hill Publishing Company, New Delhj, 3rd Revised Edition, 2008.

Reference Books

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (ln Sl Units): Statics and Dynamics", Tata McGraw-Hill Publishing Company, New Delhi, 8th Edition 2004.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", Pearson Education. 11th Edition. 2010.

Online Resources

1. http://nptel.ac.in/courses/122104015/
2. http://nptel.ac in/courses/112103109/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2		1								2	3		
CO 2	3	2		1								2	3		
CO 3	3	2		1								2	3		
CO 4	3	2		1								2	3		
CO 5	3	2		1								2	3		
	3-High					**2- Medium**						**1-Low**			

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Understand	Quiz	5	15
Apply	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	
Remember	10	10	10	30
Understand	20	10	10	30
Apply	20	30	30	40
Analyze				
Evaluate				
Create				

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23LET08	தமிழரும் தொழில்நுட்பமும் TAMILS AND TECHNOLOGY (Common to all B.E. / B.Tech Programme)	L	T	P	C
		1	0	0	1
Nature of Course	Humanities and Sciences				
Pre requisites	Tamil				

Course Objectives

The course is intended to

1. Introduce students to the great technology of ancient Tamil society.
2. Realize the contribution of various technologies for the development of governing area.
3. Highlighting the different manufacturing technology to make the coins, jewels, stones, art etc.
4. Know the role of agriculture, water management system and food processing.
5. Learn about the Scientific Tamil and Tamil computing of the past and how it has evolved over the generations.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Remember the life style and technology of the Sangam people.	Remember
CO 2	Get an updated knowledge of ancient designing and construction of House, Temple, hero stones etc.	Understand
CO 3	Learnt the speciality of manufacturing technology types and usages.	Understand
CO 4	Gain the knowledge on production of agricultural products based on the ancient technologies.	Understand
CO 5	Understand the evaluation of Tamil language through the digital system.	Understand

Course Contents (in Tamil)

அலகு - I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	2
சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில் நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.		
அலகு - II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	2
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு கட்டிடக் கலை – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.		

அலகு - III	உற்பத்தித் தொழில் நுட்பம்	2
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சின்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் -நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு - IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	2
அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழிகள் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார்.		
அலகு - V	அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்	2
அறிவியல் தமிழின் வளர்ச்சி – கணினித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின் பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.		
		Total : 10 Periods

Course Contents (in English)

Module – I	WEAVING AND CERAMIC TECHNOLOGY	2
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
Module – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**2**
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.		
Module – III	**MANUFACTURING TECHNOLOGY**	**2**
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold Coins as source of history - Minting of Coins – Beads making-industries Stone beads –Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.		
Module – IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**2**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea – Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		
Module – V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**2**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.
Total : 10 Periods

பார்வை நூல்கள் (TEXT-CUM-REFERENCE BOOKS)

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நகரிகம் (தொல்லியல் துறைவெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

23LEE02	ADVANCED COMMUNICATIVE ENGLISH (Common to all B.E. / B.Tech Programme)	L	T	P	C
		2	0	2	3
Nature of Course	Humanities and Sciences				
Pre requisites	Communicative English				

Course Objectives

The course is intended to

1. Hone professional communication skills, including email etiquette and formal presentation.
2. Develop advanced vocabulary and collocation for official communication.
3. Communicate effectively and actively in social interactions.
4. Improve writing skills such as project and report writing for various purposes.
5. Foster collaborative communication abilities through group discussion in diverse contexts.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Communicate professionally in various contexts.	Understand
CO 2	Make use of common English phrases and vocabulary.	Understand
CO 3	Integrate basic English communication skills at a personal and a professional level in day-to- day interaction.	Apply
CO 4	Implement listening, reading and writing skills in real - life situations	Apply
CO 5	Decipher collaborative communication skills through diversified contexts.	Understand

Course Contents

Module – I	TECHNICAL VOCABULARY AND USAGE	9
Grammar: Technical Vocabulary (Synonyms and antonyms) - Articles - Reported Speech - **Listening**: Listening to video lectures (TED / INK Talks) **Speaking**: Describing pictures, places – Speaking practice to improve pronunciation **Reading**: Critical reading from the given text **Writing**: Job Application with Resume - E mail writing.		
Module – II	**EFFECTIVE OFFICIAL COMMUNICATION**	**9**
Grammar: Collocation – Question tags – Prepositions **Listening:** Listening to telephonic conversation **Speaking:** Role plays – Telephonic Etiquette and telephonic phrases **Reading:** Company profile - Advertisement (job / product) **Writing:** – Preparing Memo – Prepare Circular, Agenda and Minutes – Placing Order – Prepare Advertisement.		
Module – III	**TECHNICAL LANGUAGE SKILLS FOR CONVERSATION**	**9**
Grammar: Degrees of Comparison – Conjunctions **Listening:** Sports commentaries – Animated short stories **Speaking:** Asking for and giving directions – Describing simple process **Reading:** Reading and understand technical vocabulary **Writing:** Letter to the Editor – Review of Favourite Movie / Book – Recommendations.		

Module – IV	LANGUAGE FOR BUSINESS CORRESPONDENCE	9
Grammar: Idioms and Phrases – Single line definitions Phrasal verbs **Listening:** Listening to informal communication **Speaking:** Narrating personal experience **Reading:** Speed reading – reading passage within the time limit **Writing:** Project writing – Report writing (Accident and Survey) – Preparing welcome address and vote of thanks.		
Module – V	**VERBAL ABILITY FOR WRITING**	**9**
Grammar: Verbal Analogy – Cause and effect expressions **Listening:** Listening to Iconic Speeches - debate and reviewing the performance **Speaking:** Group communication skills – Discussing social issues and current affairs **Reading:** Short story – critical reading **Writing:** Itinerary –Interpretation of charts (Flow chart and Pie chart) - Essay Writing and Paragraph.		
		Total : 45 Periods

Laboratory Components:

S.No	List of Experiments	CO Mapping	RBT
1	Describing Picture / Place	1	Understand
2	Listening	1	Understand
3	Role Play	2	Understand
4	Prepare Circular, Agenda & Minutes	2	Understand
5	Asking and Giving Directions	3	Apply
6	Narrate a Favourite Movie / Book	3	Apply
7	Welcome Address	4	Apply
8	Vote of Thanks	4	Apply
9	Discussing Social Issues	5	Understand
10	Interpretation of Charts	5	Understand
		Total	**15 Periods**

Text Books

1. Rizvi, Ashraf.M, "Effective Technical Communication", Tata McGraw Hill Publishing Company Limited, New Delhi, 8th Edition, 2020.
2. Hewings. M, "Advanced English Grammar", 3rd Edition, Cambridge University Press, Chennai, 9th Edition, 2019.
3. Board of Editors, "Using English – A Course book for Undergraduate Engineers and Technologists", Orient Black Swan Private Limited, Hyderabad, 3rd Edition, 2019.

Reference Books

1. Dr. Krishnakumar TP, "Rudiments of Communication Skills", Buddha Publication, 1st Edition, 2023.
2. Raman M & Sangeetha Sharma, "Technical Communication", Oxford University Press, USA, 13th Edition, 2018.
3. Dhanavel S. P., "English and Soft Skills", 1st Edition, Orient Black Swan Private Limited, Hyderabad, 2010.

Web References:

1. https://nptel.ac.in/courses/111104031
2. https://nptel.ac.in/courses/111106139
3. https://nptel.ac.in/courses/111105134

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1									1	3	1		2	
CO 2									1	3	1		2	
CO 3									1	3	1		2	
CO 4									1	3	1		2	
CO 5									1	3	1		2	
	3-High				2-Medium				1-Low					

Summative assessment						
Bloom's Level	Continuous Assessment (IAE)					Final Examination (FE) [50marks]
	Theory Marks				Practical	
	IAE-I [5]	IAE-II [10]	IAE-III [10]	Attendance [5]	Rubric based CIA [20 Marks]	
Remember	25				4	10
Understand	25	25	25		8	20
Apply		25	25		8	20
Analyse						
Evaluate						
Create						

23PH202	MATERIALS PHYSICS (Common to Aero, Agri, Civil, FT, Mech, PCT & SF)	L	T	P	C
		3	0	2	4
Nature of Course	Basic Sciences				
Pre requisites	Fundamentals of Basic Physics				

Course Objectives

The course is intended to

1. Impart knowledge in production of laser and their applications in engineering and medical field.
2. Understand on the concept and properties of matter like elasticity and its applications.
3. Provide a valuable theoretical introduction and an overview of the fundamental structures of the crystal physics.
4. Apply the concepts of thermal conductivity to solve the thermal coefficients.
5. Give an idea on new engineering materials like shape memory alloys, metallic glasses and nanomaterials.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Compare the types of lasers for various industrial applications.	Understand
CO 2	Study the elastic behavior and working of torsional pendulum.	Understand
CO 3	Account for how crystalline materials are studied using miller indices, including concepts like coordination number and packing factor.	Understand
CO 4	Demonstrate the thermal conductivity of good and bad conductors.	Apply
CO 5	Explain a conceptual understanding about the properties of new engineering materials like shape memory alloys, metallic glasses and nanomaterials.	Apply

Course Contents

Module – I	LASER PHYSICS	9
Lasers: Introduction- characteristics of laser - population of energy levels, Einstein's A and B coefficients derivation - resonant cavity - semiconductor lasers: homojunction and heterojunction - Applications of lasers - particle size determination and holography.		
Module – II	**PROPERTIES OF MATTER**	**9**
Elasticity - stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever - uniform and non-uniform bending - I-shaped girders.		
Module – III	**CRYSTAL PHYSICS**	**9**
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures.		

Module – IV	THERMAL PHYSICS	9
Transfer of heat energy - thermal expansion of solids and liquids - expansion joints - bimetallic strips - thermal conductivity - Forbe's and Lee's disc method: theory and experiment – thermal insulation - applications: heat exchangers in refrigerators, ovens and solar water heaters.		
Module – V	**MODERN ENGINEERING MATERIALS**	**9**
Metallic glasses – preparation, properties and applications – Shape memory alloys – Types, characteristics and applications – Nanomaterials – preparation– Physical Vapour Deposition (PVD) - sol gel method, properties and applications. Carbon Nano Tube (CNT) –properties and applications.		
		Total : 45 Periods

Laboratory Components (Any Five)

S.No	List of Experiments	CO Mapping	RBT
1	Determination of wavelength and particle size of the given Laser beam.	CO1	Apply
2	Determination of numerical aperture and acceptance angle of an optical fiber.	CO1	Apply
3	Determination of the rigidity modulus of a given wire by using Torsion pendulum.	CO2	Apply
4	Determination of Young's modulus of a material by non-uniform bending method.	CO2	Apply
5	Determination of Young's modulus of a material by uniform bending method.	CO2	Apply
6	Determination of thermal conductivity of a bad conductor by Lee's Disc method.	CO4	Apply
		Total	**15 Periods**

Text Books

1. Bhattacharya, D.K and Poonam, T, "Engineering Physics", Oxford University Press, 2nd edition, 2015.
2. M.N. Avadhanulu, M.N. &Kshirsagar PG. "A Text book of Engineering Physics", S.Chand and company, Ltd., New Delhi, 10th edition, 2014.
3. Singh Dheeraj Kumar, "Nanomaterials", Springer International Publishing, 1st Edition, 2023.

Reference Books

1. David Halliday, Robert Resnick and Jearl Walker., "Principles of Physics", Wiley, 10th Edition, 2014.
2. Raymond A Serway and John W Jewett., "Physics for Scientists and Engineers", Cengage Learning, 9th Edition, 2019.

Web References:

1. https://nptel.ac.in/courses/115/107/115107095/
2. https://spaceplace.nasa.gov/laser/en/
3. https://www.coursera.org/lecture/fe-exam/stresses-in-beams-strains-in-pure-and-nonuniform-bending-6aMRx

4. https://nptel.ac.in/courses/113106093

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	1												
CO 2	3	1												
CO 3	3	2	2											
CO 4	3	2	2											
CO 5	3													
	3-High				2-Medium				1-Low					

Summative Assessment						
Bloom's Level	Continuous Assessment (IAE)					Final Examination (FE) [50marks]
	Theory Marks				Practical	
	IAE-I [5]	IAE-II [10]	IAE-III [10]	Attendance [5]	Rubric based CIA [20 Marks]	
Remember	10	10	10			20
Understand	35	35	35		40	60
Apply	5	5	5		60	10
Analyse						10
Evaluate						
Create						

23CS203	PROBLEM SOLVING USING PYTHON (Common to AERO, CIVIL, FT, MECH, PCT, S&F)	L	T	P	C
		3	0	2	4
Nature of Course	Engineering Sciences				
Prerequisites	Mathematical and Logical Knowledge				

Course Objectives

The course is intended

1. Learn the basics of algorithmic problem solving.
2. Think logically and write algorithms and draw flow charts for problems.
3. Make use of python functions and call them.
4. Utilize the Python data structures — lists, tuples, dictionaries and files.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Recall algorithmic solutions to simple computational problems and read,write, execute by simple python programs	Remember
CO 2	Classify and Read, Write, Execute by hand simple python programs.	Understand
CO 3	Structure simple python programs for solving problems.	Understand
CO 4	Examine simple Python programs using conditionals and loops for solving problems	Apply
CO 5	Show the python string functions and lists	Apply
CO 6	Practice the compound data using python Tuples, Dictionaries, Files and Packages.	Apply

Course Contents

MODULE – I Basics of Computers & Problem solving 9

Computer Basics–Components-Computer organization-Computer Software-Types of software - Software Development steps -Need for logical analysis and thinking- Algorithms –Flowchart.

MODULE – II Introduction of Python Programming 9

Introduction- Python IDLE Installation- Python Interpreter- Interactive and script mode-Values and types, variables, operators, expressions, statements, precedence of operators, Multiple assignments, comments, Input and Output Statements.

MODULE – III Control statements and Functions 9

Conditional (if), alternative (if-else), chained conditional (if-elif-else)- Iteration- while,for,break,continue, pass – Functions - Introduction, inbuilt functions, user defined functions, recursion.

MODULE – IV Strings, Lists 9

Strings- String slices, immutability, string methods and operations- Lists- creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions.

MODULE – V Tuples, Dictionaries, Files and Packages 9

Tuples- Tuple assignment, lists and tuples, Tuple as return value- Dictionaries- operations and methods, Files and Exception-Text files, reading and writing files.

Total : 45 Periods

Laboratory Components

S.No	List of Exercises	CO Mapping	RBT
1	Write a algorithm & draw flowchart for simple Computational problems.	CO1	Apply
2	Write a program to perform different arithmetic operations on numbers in python.	CO1	Apply
3	Write a python program to implement the various control structures.	CO2	Apply
4	Write a python program for computational problems using recursive function.	CO2	Apply
5	Demonstrate use of list for data validation.	CO3	Apply
6	Develop a python program to explore string functions.	CO3	Apply
7	Write a python program to find a given number is ODD or EVEN	CO4	Apply
8	Write a python class to reverse a string word by word	CO4	Apply
9	Develop python programs to perform operations on dictionaries.	CO5	Apply
10	Write a python program to read and write into a file.	CO5	Apply

Text Books

1. Reema Thareja, "Problem Solving and Programming with Python", Oxford University Press, 1st Edition 2021.
2. Dr. R. Nageswara Rao, "Core Python Programming", Dream tech Press, 1st Edition 2019.

Reference Books

1. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2nd Edition 2021.
2. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python", Mc-Graw Hill Education, 1st Edition 2020.
3. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India Edition, 2nd Edition 2019.
4. Timothy A. Budd," Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 1st Edition 2015.

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Additional References

1. **Python Research Association of India** - https://www.araiindia.com/services/technology-and-products
2. **NPTEL** - https://nptel.ac.in/courses/107/106/107106088/
3. **MOOC Courses** - https://www.mooc-list.com/tags/automotive-engineering

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	3							3	3	3	3
CO2	3	3	3	2	3							3	3	3	3
CO3	3	3	3	2	3							3	3	3	3
CO4	3	3	3	2	3							3	3	3	3
CO5	3	3	3	2	3							3	3	3	3
CO6	3	3	3	2	3							3	3	3	3
	3	High				2	Medium					1	Low		

Bloom's Level	Summative Assessment						
	Continuous Assessment						Final Examination (Theory) [50]
	Theory				Practicals		
	IAE-I[5]	IAE-II[10]	IAE-III[10]	Attendance[5]	Rubric Based CIA [10]	Model Examination [10]	
Remember	10	10	10		20		20
Understand	20	20	20		20		40
Apply	20	20	20		10		40
Analyze							
Evaluate							
Create							

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23ME202	MECHANICAL ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	2	1
Nature of Course	Engineering Sciences				
Prerequisites	Fundamentals of Science				

Course Objectives

The course is intended to

1. To practice butt joints, lap joints, and T-joints by metal arc welding.
2. To fabricate models using sheet metal
3. To make joints using carpentry tools.
4. To provide hands-on training in drilling practice
5. To build pipeline as per location and functional requirements.

Course Outcomes

On successful completion of the course, the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Experiment with arc welding equipment to join the structures	**Apply**
CO 2	Make the models using sheet metal	**Apply**
CO 3	Fabricate joints in carpentry components	**Apply**
CO 4	Construct the methods of a drilling operation	**Apply**
CO 5	Carry out basic types of pipe connections including plumbing works	**Apply**

List of Exercises

S.No	Exercises	CO Mapping	RBT Level
Welding			
1	Lab Joint Using Arc Welding		
2	Butt Joint Using Arc Welding		
3	Tee Joint Using Arc Welding		
Sheet Metal			
4	Fabrication of Tray Using Sheet Metal		
5	Fabrication of Cone Using Sheet Metal		
Carpentry			
6	Cross Lab Joint Using Wood		
7	Tee Lab Joint Using Wood		
8	Dove-Tail Joint Using Wood		
Special Machines			
9	Drilling of Hole in The Given Work Piece		
Plumbing			
10	External Thread Cutting		
11	Domestic Water Pipe Line Connection.		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1			3									2	2		
CO 2			3									2	2		
CO 3			3									2	2		
CO 4			3									2	2		
CO 5			3									2	2		
	3-High				**2-Medium**				**1-Low**						

Summative Assessment based on continuous and Final Examination		
Bloom's Category	**Rubrics-based continuous assessment [60 Marks]**	**Final Examination [40 Marks]**
Remember		
Understand	**30**	2**0**
Apply	3**0**	**20**
Analyse		
Evaluate		
Create		

23ME301	Engineering Thermodynamics	L	T	P	C
		3	1	0	4
Nature of course	Professional Core				
Pre requisites	Engineering Mathematics and Physics				

Course Objectives

The course is intended to

1. Acquire knowledge on thermodynamic systems, properties, laws of thermodynamics, entropy.
2. Examine different thermal systems using the first and second laws of thermodynamics.
3. Improve your ability to solve thermodynamic system problems utilizing a variety of relations.
4. Study the thermodynamic properties of pure substances and its phase change processes.
5. Identify the ideal and real gases equations of state.
6. Use thermodynamic relations to estimate the various properties of the gas mixture.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Explain the thermodynamic properties and Solve the problems related to closed and open systems.	Understand
CO 2	Select the second law of thermodynamics and entropy principle to various thermodynamic systems.	Apply
CO 3	Use the various thermodynamic relations to available and unavailable energy.	Apply
CO 4	Calculate the properties of steam using PV diagrams, H-S diagrams and steam power cycle.	Apply
CO 5	Determine the properties of ideal gases, real gases and gas mixtures using gas laws.	Apply

Course Contents

Module – I Basic Concepts and First Law of Thermodynamics 12

Basic Concepts: Microscopic and Macroscopic approaches, Thermodynamic systems, Control volume, Thermodynamic properties, Processes, Cycle, Thermodynamic equilibrium, Quasi-static process, Work and Heat transfer, Displacement work and other modes of work, Point and path function, Specific heats, Zeroth law of thermodynamics, First Law of Thermodynamics: First law for flow and non flow processes, various modes of energy, internal energy and enthalpy, Steady Flow Energy Equation (SFEE), Examples of steady flow processes, PMM-1, Limitations of the First Law.

Module – II Second Law of Thermodynamics and Entropy 12

Second law of thermodynamics: Definition of heat engine, heat pump and refrigerator, thermal efficiency and COP, Kelvin-Planck and Clausius statements, Equivalence of Kelvin-Planck and Clausius statements, Reversibility and Irreversibility, Carnot cycle. Entropy: Clausius Inequality, Definition of Entropy, Entropy change in reversible and Irreversible process, Principle of increase of entropy, Entropy generation in a closed system and open system.

Module – III Availability and Thermodynamic Relations 12

Availability: Available and unavailable energy, concept of availability, irreversibility, Maximum Work in a Reversible Process, Availability applied to Non - Flow and Flow Processes. Thermodynamic relations: Helmholtz and Gibbs functions, Maxwell relations, Coefficient of volume expansion and isothermal compressibility, T-ds relations, Joule-Thomson coefficient, Clausius Clapeyron equation.

Module – IV Properties of Pure Substance and Rankine cycle 12

Properties of pure substances: Formation of steam and its thermodynamic properties, P-V, P-T,T-S and H-S Diagrams for a Pure Substance, Quality and Dryness Fraction, Use of Steam Tables and Mollier Chart for thermodynamic Processes, Determination of dryness fraction, Application of thermodynamic laws for pure substances, Rankine Cycle: Basic Rankine cycle – Rankine cycle with reheating and regeneration.

Module – V Ideal, Real Gases and Gas Mixtures 12

Ideal and Real Gases: Definition, Equations of state for ideal and real gases -Vander Waal's equation, Reduced properties-.Compressibility factor, Generalized Compressibility Chart and its use. Gas mixtures: Mole Fraction, Mass fraction, Dalton's Law of partial pressure, Equivalent Gas constant and Molecular Internal Energy, Enthalpy, Specific Heats and Entropy of Mixture of perfect gases and vapour.

Total : 60 Periods

Note: Steam Tables with Mollier Chart and Compressibility Chart shall be supplied during Examination.

Text Books

1. Yunus A. Cengel and Michael A. Boles, Thermodynamics: An Engineering Approach, Tata-McGraw Hill Pub, 10th Edition, 2023.
2. P. K. Nag, Engineering Thermodynamics, Tata-McGraw Hill Pub, 6th Edition, 2017.

Reference Books

1. Rajput, Engineering Thermodynamics, Laxmi Publications, 5th Edition, 2010
2. Gordon J. Van Wylan& Richard E. Sonntagg, Fundamentals of Thermodynamics, Wiley Eastern Ltd, 7th Edition, 2009.
3. Dr.R.Yadav, Fundamentals of Engineering Thermodynamics, Central Publishing House, Revised 7th Edition, 2016.

Additional References

1. http://nptel.ac.in/courses/112104113/
2. http://nptel.ac.in/courses/112108148/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	1										3		
CO 2	3	2	1										3		
CO 3	3	3	2										2		
CO 4	3	3	2										2		
CO 5	3	3	1										2		
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand/Apply	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (100)**
	IAE – 1 (5)	**IAE – 2 (10)**	**IAE – 3 (10)**	
Remember	20	10	10	20
Understand	30	10	10	20
Apply		30	30	60
Analyze				
Evaluate				
Create				

23ME302	Engineering Materials and Metallurgy (Common to Aero & Mech)	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Pre requisites	Material Physics				

Course Objectives

The course is intended to

1. Develop the knowledge on the phase diagram of Iron and Steel.
2. Transfer knowledge on ferrous and non ferrous alloys.
3. Give the awareness on Heat treatment of Steels.
4. Acquire the knowledge on non metallic materials.
5. Identify the testing methods to determine the properties of materials.
6. Provide the knowledge on material science and their applications.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Interpret the phase changes, structures, properties and applications of steel and cast iron	Understand
CO 2	Relate the behaviour of Ferrous and Non Ferrous Alloys	Understand
CO 3	Demonstrate the heat treatment process of steels.	Understand
CO 4	Outline the process, structure and applications of Non metallic materials and composites.	Understand
CO 5	Prefer the actions of materials under several loading conditions.	Apply

Course Contents

Module –I Alloys and Phase Diagrams **9**

Constitution of alloys – Phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Carbon equilibrium diagram. Classification of steels and cast Iron.

Module -II Ferrous and Nonferrous Alloys **9**

Effect of alloy additions on steel - Stainless and tool steels - HSLA, Maraging steels - Al-Cu alloys - precipitation strengthening treatment - Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

Module-III Heat Treatment of Steel **9**

Definition – Full annealing, stress relief, recrystallization and spheroidising – normalizing, Hardenability-Jominy end quench test - case hardening, carburizing, nitriding and cyaniding - Flame and Induction hardening.

Module-IV Non Metallic Materials **9**

Polymers – types of engineering polymers, Properties and applications of various thermo and thermosetting polymers-PE, PP,PVC, ABS, PMMA, PS, Urea and Phenol formaldehydes- Engineering Ceramics - Al_2O_3, SiC, Si_3N_4 and SIALON -Introduction to composite materials.

Module-V Testing of Materials **9**

Testing of materials under tension, compression and shear loads – Brinel, Rockwell and Vickers Hardness tests, Impact test - Izod and Charpy, fatigue and creep tests. Mechanism of plastic deformation-slip and twinning.

Total : 45 Periods

Text Books

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 9th Indian Reprint 2009.
2. Williams D Callister, "Material Science and Engineering" 2nd edition Wiley India Pvt Ltd, Revised Indian Edition 2014.

Reference Books

1. Dieter, G.E. "Mechanical Metallurgy",3rd Edition McGraw-Hill, 2017.
2. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 6th Edition 2015.
3. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 9th Edition, 2013.

Additional / Web References

1. https://nptel.ac.in/courses/112/108/112108150.
2. http://www.issp.ac.ru/ebooks/books/open/Materials Science and Technology.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	2										2	2	
CO 2	3	2	2										2	2	
CO 3	3	2	2										2	2	
CO 4	3	2	2										2	2	
CO 5	3	2	2										2	2	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	40	40	20	60
Apply			20	20
Analyze				
Evaluate				
Create				

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20ME303	Fluid Mechanics and Machinery	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Pre requisites	Engineering mechanics				

Course Objectives

The course is intended to

1. Know the properties of fluids and concept of control volume.
2. Learn the conservation laws of flow through pipes.
3. Understand the importance of dimensional analysis
4. Understand the importance of various types of flow in pumps.
5. Understand the importance of various types of flow in turbines.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Identify the fluid properties and measure the flow characteristics	Apply
CO 2	Evaluate the loss of energy in flow through pipes	Evaluate
CO 3	Model the relationships for the flow parameters of fluids.	Apply
CO 4	Examine the performance of pumps for a given application	Analyse
CO 5	Select suitable turbine for given application and evaluate the operating characteristics	Apply

Course Contents

Module –I Fluid Properties and Flow Characteristics **9**

Units and dimensions- Properties of fluids, Flow characteristics - concept of control volume - application of continuity equation, energy equation and momentum equation.

Module –II Flow Through Circular Conduits **9**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuliBoundary layer concepts – Darcy Weisbach equation -friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

Module –III Dimensional Analysis **9**

Need for dimensional analysis - methods of dimensional analysis - Similitude -types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

Module –IV Pumps **9**

Impact of jets - Euler"s equation - Theory of roto-dynamic machines – various efficiencies- velocity components at entry and exit of the rotor- velocity triangles - pumps- working principle - work done- performance curves.

Module –V Turbines **9**

Classification of turbines - heads and efficiencies - velocity triangles. working principles - work done by water on the runner - draft tube. Specific speed - unit quantities - performance curves for turbines – governing of turbines.

Total : 45 Periods

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Text Books

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 22nd edition, 2019.
2. Kumar K. L., "Engineering Fluid Mechanics", Tata-McGraw Hill , 4th Edition, 2017.

Reference Books

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, “Fluid Mechanics and Machinery”, 2011.
3. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co.,9th edition 2017

Additional / Web References

1. http://www.efluids.com/
2. https://www.quora.com/What-is-fluid-machines
3. https://nptel.ac.in/courses/112104117/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	3										1	2	
CO 2	3	2	3										1	2	
CO 3	3	2	3										1	2	
CO 4	3	3	2										1	2	
CO 5	3	2	3										1	2	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Understand	Online Quiz	5	15
Apply	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	
Remember				
Understand	20	20	20	40
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

23UH001	UNIVERSAL HUMAN VALUES (Common to all B.E. / B.Tech Programme)	L	T	P	C
		3	0	0	3
Nature of Course	Humanities and Sciences				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Encourage respect for the inherent dignity and worth of all individuals, regardless of differences in race, ethnicity, gender, religion, or socioeconomic status.
2. Cultivate empathy and compassion towards others, promoting understanding and solidarity across diverse communities.
3. Promote peaceful coexistence and harmony among individuals and communities.
4. Foster a sense of responsibility towards the environment and future generations, promoting sustainable practices and conservation efforts.
5. Hold and celebrate cultural diversity, recognizing the richness and value of different traditions, languages, and perspectives.
6. Contribute to the realization of universal human values and create a more just, compassionate, and sustainable world.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Embrace values such as empathy, tolerance, and respect can lead to decreased conflict and violence, both at interpersonal and societal levels.	Understand
CO 2	Support values like equality, justice, and human rights can lead to more equitable societies, where everyone has access to opportunities and resources	Understand
CO 3	Emphasize values such as empathy, compassion, and honesty fosters healthier and more meaningful relationships among individuals and groups.	Apply
CO 4	Grasp values of environmental stewardship and responsibility contributes to sustainable development practices that preserve natural resources.	Apply
CO 5	Celebrate cultural diversity and promoting values of inclusivity and acceptance enriches societies by fostering creativity, innovation, and mutual understanding	Understand
CO 6	Create a world that is more just, compassionate, and sustainable for all.	Apply

Course Contents

Module – I	NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION	9

Purpose and motivation for the course, recapitulation from Universal Human Values-I - Self-Exploration – what is it? – Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration – Continuous Happiness and Prosperity-A look at basic Human Aspirations - Right understanding, Relationship and Physical Facility - the basic requirements for fulfilment of aspirations of every human being with their correct priority – Understanding Happiness and Prosperity correctly -

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A critical appraisal of the current scenario – Method to fulfil the above human aspirations: understanding and living in harmony at various levels.		
Module – II	**UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!**	**9**
Understanding human being as a co-existence of the sentient 'I' and the material 'Body' – Understanding the needs of Self ('I') and 'Body'- happiness and physical facility – Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) – Understanding the characteristics and activities of 'I' and harmony in 'I' – Understanding the harmony of I with the Body : Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Health.		
Module – III	**UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN- HUMAN RELATIONSHIP**	**9**
Understanding values in human - human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship – Understanding the meaning of Trust; Difference between intention and competence - Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship – Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals – Visualizing a universal harmonious order in society-Undivided Society, Universal Order- from family to world family.		
Module – IV	**UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE-WHOLE EXISTENCE AS COEXISTENCE**	**9**
Understanding the harmony in the Nature – Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature – Understanding Existence as Co-existence of mutually interacting units in all- pervasive space Holistic perception of harmony at all levels of existence.		
Module – V	**IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS**	**9**
Natural acceptance of human values – Definitiveness of Ethical Human Conduct – Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in professional ethics – Case studies of typical holistic technologies, management models and production systems – Strategy for transition from the present state to Universal Human Order: **a.** At the level of individual: as socially and ecologically responsible engineers, technologists and managers **b.** At the level of society: as mutually enriching institutions and organizations		
		Total : 45 Periods

Text Books

1. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.
2. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.
3. A N Tripathy, Human Values, New Age International Publishers, 2003.

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
3. Human Values, A. N. Tripathi, New Age Intl.Publishers, NewDelhi, 2004.

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Web References

1. https://www.studocu.com/in/document/i-k-gujral-punjab-technical-university/universal-human-values/uhv-complete-notes/46743542.
2. https://www.youtube.com/watch?v=NhFBzn5qKIM&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So
3. https://www.youtube.com/watch?v=Ff0LUTOCuLE&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So&index=16

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1									1	2	1		1	-
CO 2									1	2	1		1	
CO 3									1	2	1		1	
CO 4									1	2	1		1	
CO 5									1	2	1		1	
	3-High				2-Medium				1-Low					

Formative assessment			
Bloom's Level	Continuous Assessment (IAE)		Total marks
	Assessment component	Marks	
Remember	Online Quiz	5	15
Understand	Tutorial class/Assignment	5	
	Attendance	5	

Summative assessment				
Bloom's Level	Continuous Assessment (IAE)			Final Examination [60 marks]
	Theory Marks			
	IAE-I [5]	IAE-II [10]	IAE-III [10]	
Remember	20	10	10	10
Understand	30	20	20	20
Apply		20	20	20
Analyse				
Evaluate				
Create				

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23MA301	TRANSFORMS AND BOUNDARY VALUE PROBLEMS (Common to Aero, Agri, Civil, ECE, EEE, FDT, Mech, PCT, S&F)	L	T	P	C
		3	0	2	4
Nature of Course	Basic Sciences				
Pre requisites	Foundations of Mathematics				

Course Objectives

The course is intended to

1. Learn about linear and non-linear partial differential equations and obtain their solutions using various techniques.
2. Gain familiarity with Fourier series.
3. Orient Fourier series techniques to solve one dimensional wave and heat equations.
4. Provide the concept of Fourier transforms and its inverse.
5. Introduce the concept of Z-transforms and difference equations.
6. Utilize advanced mathematical techniques to solve complex boundary value problems, reflecting mastery in mathematical transformations.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Identify linear and non-linear partial differential equations.	Apply
CO2	Construct the Fourier series of a given function and apply in the field of Engineering.	Apply
CO3	Interpret solutions of one dimensional wave and heat equations.	Apply
CO4	Implement Fourier transforms in engineering field .	Apply
CO5	Illustrate the Z-transforms and difference equations.	Apply
CO6	Develop mathematical techniques to solve the boundary value problems.	Apply

Course Contents:

Module – I	PARTIAL DIFFERENTIAL EQUATIONS	9
Solution of standard types of first order non-linear partial differential equations: (i) f(p,q)=0, (ii) Clairaut's type - Lagrange's linear equation - linear partial differential equations of second order with constant coefficients of homogeneous equations.		
Module – II	**FOURIER ANALYSIS**	**9**
Dirichlet's Conditions - Fourier series for periodic functions - Expansion of periodic functions with period $(0, 2\pi)$ and period $(-\pi, \pi)$ – Half Range Series - Root mean square value - Parseval's identity – Harmonic Analysis.		

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Module – III	FOURIER TRANSFORMS	9
Statement of Fourier integral theorem – Fourier transforms pair: Fourier transforms and Inverse Fourier transforms – Fourier sine transforms -Fourier cosine transforms – Transforms of simple functions – Convolution Theorem - Parseval's identity.		
Module – IV	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS**	**9**
Z-transforms - Properties – Inverse Z-transform: Partial fraction method and Convolution theorem - Formation of difference equations –Solution of difference equations using Z – transform.		
Module – V	**APPLICATIONS TO PARTIAL DIFFERENTIAL EQUATIONS**	**9**
Classification of second order Partial differential equations – Method of separation of variables – Solutions of one dimensional wave equation – Solutions of one dimensional heat equation – Application to Boundary value problems.		
		Total: 45 Periods

Text Books:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., 3rd edition, 2016.
2. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2021.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 2014.

Reference Books:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Lakshmi Publications Pvt Ltd, 9th Edition, 2017.
2. Ramana.B.V,"Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company Limited, 4th Edition, 2017.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Publications, 10th Edition, 2023.

Additional References:

1. https://archive.nptel.ac.in/courses/111/101/111101153
2. https://www.youtube.com/watch?v=ygOjw0_Kh8k.
3. https://archive.nptel.ac.in/courses/111/106/111106111.

Laboratory Components using MATLAB:

S.No	List of Experiments	CO Mapping	RBT
1	Solutions of Clauirat's form	1	Apply
2	Solution of second order homogeneous differential equations with constant coefficients	1	Apply
3	Fourier Series in $(0,2\pi)$	2	Apply
4	Harmonic Analysis in Fourier Series	2	Apply

5	Fourier Transform	3	Apply
6	Inverse Fourier Transform	3	Apply
7	Z - Transform	4	Apply
8	Inverse Z - Transform	4	Apply
9	One dimensional wave equation	5	Apply
10	One dimensional heat equation	5	Apply

Total: 30 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										2		
CO2	3	2	2										2		
CO3	3	2	1										2		
CO4	3	2	1										1		
CO5	3	3	2										2		
CO6	3	2	2										2		
	3	High				2	Medium					1	Low		

Bloom's Level	Summative Assessment						
	Continuous Assessment						Final Examination (Theory) [50]
	Theory			Practical			
	IAE I (5)	IAE II (10)	IAE III (10)	Attendance [5]	Rubric based [10]	Model Exam [10]	
Remember	10	10	10				10
Understand	10	10	10		40	40	30
Apply	30	30	30		60	60	60
Analyze							
Evaluate							
Create							

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23ME304	Manufacturing Technology-I	L	T	P	C
		3	0	2	4
Nature of course	Professional Core				
Pre-requisites	Fundamentals of Mechanical Engineering				

Course Objectives:

The course is intended to

1. Describe the various aspects of different manufacturing techniques and casting methods
2. Developing a broad knowledge of welding methods for making various joints using different techniques.
3. Demonstrate the metal forming processes such as Hot and Cold Working, Rolling, Forging, Extrusion, and Drawing.
4. Acquire knowledge about the tools, equipment, machinery, and operations required for these metal forming processes.
5. Developing the basic concepts of plastic components in manufacturing processes.
6. Understand and compare the functions and applications of different manufacturing technology process tools.

Course Outcomes:

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Choose different metal casting processes, associated defects, merits and demerits.	Understand
CO 2	Categories and select appropriate different metal joining processes using various techniques.	Understand
CO 3	Identify various hot-working and cold-working methods of metals.	Understand
CO 4	Design various sheet metal-making processes.	Apply
CO 5	Organize various methods of manufacturing plastic components.	Apply

Course Contents

Module– I Metal Casting Processes **9**

Principles of special casting processes; advantages and applications of metal casting, patterns, pattern making, pattern materials, pattern types, pattern allowances, and mold materials. Sand Casting, Molding machines – Melting furnaces, shell molding, investment casting, pressure die casting, centrifugal casting, CO2 process, stir casting, Defects in Sand casting process remedies.

Module– II Metal Joining Processes **9**

Introduction: Gas tungsten arc welding, Gas metal Arc welding, submerged arc welding, resistance welding, plasma arc welding, thermit welding, friction stir welding, brazing and soldering, Welding defects – inspection & remedies – Adhesive bonding.

Module– III Metal Forming Process **9**

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging Types of Rolling, Defects in rolled parts – Principle of rod and wire drawing – Tube drawing Principles of Extrusion – Types – Hot and Cold extrusion.

Module– IV Sheet Metal Processes **9**

Sheet metal forming methods – Bending Operation, Shearing, Bending, Blanking, Stretch Forming, Deep Forming. Spinning. High-velocity forming, Explosive forming, Electro-hydraulic forming - magnetic pulse forming, pneumatic and mechanical high velocity forming.

Module– V Manufacture of Plastic Components **9**

Types and characteristics of plastics - Molding of thermoplastics & Thermosetting polymers-working principles and typical applications - introduction to blow molding, Rotational molding, Film blowing, injection molding, extrusion, Thermoforming, bonding of thermoplastics.

Total: 45 Periods

Laboratory Component:

S.No.	Name of the Experiment	CO Mapping	RBT
1	Preparation of greensand mold for solid pattern	CO1	Apply
2	Preparation of greensand mould for split pattern	CO1	Apply
3	Joining of Lap Joint Using Arc Welding	CO2	Apply
4	Joining of Butt Joint Using Arc Welding	CO2	Apply
5	Joining of Tee Joint Using Arc Welding	CO2	Apply
6	Cold forming of round shape to square	CO3	Apply
7	Cold forming of round shape to hexagon	CO3	Apply
8	Preparation of Tray Using Sheet Metal	CO4	Apply
9	Preparation of Funnel Using Sheet Metal	CO4	Apply
10	Basic Connection Involving PVC / GI Pipes and Pipe Fittings	CO5	Apply
11	Joining process of T-Joint in plastics	CO5	Apply

Total: 30 Periods

Text Books

1. P.N .Rao Manufacturing Technology Volume 1 Mc Graw hill Education 5th edition, 2018.
2. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India,4th Edition, 2013.

Reference Books

1. Hajra Choudhury S.K, Hajra Choundhury A.K, and Nirjhar Roy, “Elements of Workshop Technology”, Vol. 1, 2017 2.
2. HMT, “Production Technology”, “McGraw Hill Education”, 2017.

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3. Rajput.R.K, “A Textbook of Manufacturing Technology”, 2nd ed., Laxmi Publications (P) Ltd, 2016

Additional / Web References

1. https://nptel.ac.in/courses/112107145/17
2. https://nptel.ac.in/courses/112107083/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	3	2										1	2	
CO 2	3	3	2										1	2	
CO 3	3	3	2										1	2	
CO 4	3	3	2										1	2	
CO 5	3	3	2										1	2	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Internal Assessment Examinations**			**Final Examination (100)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III(10)**	
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

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23ME305	Computer Aided Machine Drawing Laboratory	L	T	P	C
		0	0	2	1
Nature of course	Professional Core (PC)				
Pre requisites	Engineering Drawing				

Course Objectives

The course is intended to

1. Apply the Indian Standards and practice thread forms, fasteners, keys, joints, and couplings to impart knowledge
2. Visualize the machine components drawing leading to the preparation of Assembly drawings manually and using CAD with Geometric Dimensioning and Tolerancing (GD&T).
3. Experiment with the basic principles associated with CAD and demonstrate common drafting techniques and shortcuts used by professionals.
4. Utilize the advancements of CAD and their capabilities that can be used to increase the productivity.
5. Suggest information about the CAD in the industry and use its resources.
6. Prepare part and assembly drawings, bill of material of machine components and values using CAD Software.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO1	Develop the draft of components such as flange couplings and screw jacks, adhering to industry standards and conventions, and including detailed annotations and dimensioning.	Apply
CO2	Construct 2D drawings of mechanical components such as plumber blocks and universal joints.	Apply
CO3	Draft sleeve and cotter joints as per industry standards and conventions including detailed annotations, dimensioning.	Apply
CO4	Demonstrate a clear understanding of the design principles and mechanical functions of the knuckle joints component.	Apply
CO5	Apply industry standards and conventions in drafting crossheads including detailed manufacturing and professional communication.	Apply
CO6	Interpret and create detailed and precise technical drawings of mechanical components stuffing boxes and connecting rods	Apply

Introduction to GD&T- Size (S)- Form (F)- Datums Control- Location (L)- Orientation (O)- Material Modifiers- Profile Tolerances- Runout Tolerances- Outcast Symbols to Avoid Concentricity, Symmetry

Geometric Modeling And Assembly			
S.no	**Particulars**	**CO's**	**Blooms Taxonomy**
Study	Study of AutoCAD	CO1	Understand
1.	2D Drafting of Flange Coupling	CO1	Apply
2.	2D Drafting of Screw Jack	CO1	Apply
3.	2D Drafting of Plumber Block	CO2	Apply
4.	2D Drafting of Universal Joint	CO2	Apply
5.	2D Drafting of Sleeve and Cotter Joint	CO3	Apply
6.	2D Drafting of Knuckle Joint	CO4	Apply

7.	2D Drafting of Cross Head	CO5	Apply
8.	2D Drafting of Stuffing Box	CO6	Apply
9.	2D Drafting of Connection Rod	CO6	Apply
			Total : 30 Periods

Text Books

1. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013

Reference Books

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 50th Edition, Charotar Publishers, 2014.
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004.
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing" , published by Tata McGrawHill,2006

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3		3	1	3					2			3	1	
CO 2	3		3	1	3					2			3	1	
CO 3	3		3	1	3					2			3	1	
CO 4	3		3	1	3					2			3	1	
CO 5	3		3	1	3					2			3	1	
CO 6	3		3	1	3					2			3	1	
	3	High		2	Medium		1	Low							

Assessment based on Continuous and Final Examination			
Bloom's Level	**Continuous Assessment (60 marks) (Attendance – 5 marks)**		**Final Examination [40 marks]**
	Rubric based Continuous Assessment [30 marks]	**Model Examination [25 marks]**	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyze			
Evaluate			
Create			

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23ME306	Strength of Materials and Fluid Mechanics Laboratory	L	T	P	C
		0	0	2	1
Nature of course	Professional core				
Pre requisites	Strength of Materials and Fluid Mechanics, Engineering materials and metallurgy				

Course Objectives:

The course is intended to

1. Learn the principles in Fluid Mechanics theory by performing experiments in lab.
2. Study the mechanical properties of materials when subjected to different types of loading.
3. Know the principles studied in Fluid Mechanics theory by performing experiments in lab.
4. Experiment the fundamental principles of mechanics of materials (strength of materials)
5. Measure mechanical properties of deformable bodies.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Select the measurement equipment's for flow measurement.	Apply
CO 2	Examine the performance of different fluid machineries.	Apply
CO3	Experiment with Tensile and double shear tests	Apply
CO4	Utilize torsion and Impact tests.	Apply
CO5	Make use of Hardness and Deflection tests.	Apply

S.No.	Fluid Mechanics - List of Experiments	CO Mapping	Bloom's Level
1	Determination of the Coefficient of discharge of given Orifice meter and Venturi meter.	CO 1	Apply
2	Calculation of the rate of flow using Rota meter	CO 1	Apply
3	Conduct experiments and drawing the characteristic curves of Gear pump.	CO 1	Apply
4	Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump	CO 2	Apply
5	Conducting experiments and drawing the characteristic curves of reciprocating pump	CO 2	Apply
6	Conducting experiments and drawing the characteristic curves of Pelton wheel.	CO 2	Apply

			Total : 30 Periods
S.No.	**Strength of Materials - List of Experiments**	**CO Mapping**	**Bloom's Level**
1.	Tension test on a mild steel rod	CO3	Apply
2.	Double shear test on Mild steel and Aluminium rods	CO3	Apply
3.	Torsion test on mild steel rod	CO4	Apply
4.	Impact test on metal specimen	CO4	Apply
5.	Hardness test on metals - Brinnell and Rockwell Hardness Number	CO5	Apply
6.	Deflection test on beams	CO5	Apply
			Total : 30 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2		3									1	2	
CO 2	3	2		3									1	2	
CO 3	3	2		3									1	2	
CO 4	3	2		3									1	2	
CO 5	3	2		3									1	2	

3	**High**	**2**	**Medium**	**1**	**Low**

Assessment based on Continuous and Final Examination			
Bloom's Level	**Continuous Assessment (60 marks) (Attendance – 5 marks)**		**Final Examination [40 marks]**
	Rubric based Continuous Assessment [30 marks]	**Model Examination [25 marks]**	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyze			
Evaluate			
Create			

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SEMESTER IV

23ME401	Strength of Materials	L	T	P	C
		3	0	0	3
Nature of course	Engineering Sciences				
Pre requisites	Engineering Mechanics				

Course Objectives

The course is intended to

1. Understand the concepts of stress, strain, principal stresses and principal planes.
2. To provide knowledge about stress structures subjected to axial and thermal loads.
3. Study the stresses and deformations induced in thin and thick shells.
4. Study the concept of shear force and bending moment due to external loads in determinate beams and their effect on stresses.
5. Know the slopes and deflections in determinate beams by various methods.
6. Learn the stresses and deformation in circular shafts and helical spring due to torsion.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Solve the concepts of stress and strain in simple and compound bars with the importance of principal stresses and principal planes.	Apply
CO 2	Examine thin and thick shells for the applied internal and external pressure	Apply
CO 3	Develop the load transferring mechanism in beams and stress distribution due to shear force and bending moment	Apply
CO 4	Construct the slope and deflection in beams using different methods	Apply
CO 5	Apply basic equation of simple torsion in designing of shafts and helical Spring	Apply

Course Contents

Module –I Stress, Strain and Deformation of Solids **12**

Rigid bodies and deformable solids - Tension, Compression and Shear Stresses - Deformation of simple and compound bars-Thermal stresses-Elastic constants-Volumetric strains-Stresses on inclined planes – principal stresses and principal planes.

Module –II Thin Cylinders, Spheres and Thick Cylinders **12**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders-spherical shells subjected to internal pressure-Deformation in spherical shells-Lame's theorem.

Module –III Transverse Loading on Beams and Stresses in Beam **12**

Beams-types transverse loading on beams-Shear force and bending moment in beams-Theory of simple bending- bending stress distribution – Load carrying capacity – Proportioning of sections – Shear stress distribution.

Module –IV Deflection of Beams and Columns **12**

Slope and Deflection of cantilever and simply supported beams by Double integration method and Macaulay''s method. Theory of Columns Slenderness ratio, End Conditions, Equivalent length, Euler and Rankine''s formulae.

Module –V Torsion & Springs **12**

Torsion formulation, stresses and deformation in circular and hollows shafts-Stepped shafts-Deflection in shafts fixed at the both ends-Stresses in helical springs-Deflection of helical springs.

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Text Books

1. Ferdinand P Been, Russell Johnson,J.r. and John J.Dewole "Mechanics of Materials", Tata McGraw Hill Publishing „co. Ltd., New Delhi, 8th edition, 2020.
2. Bansal,R.K., "Strength of Materials", Laxmi Publications (P) Ltd.,6thedition, 2018.

Reference Books

1. R. S.Khurmi, N. Khurmi “Strength of Materials”, S.Chand & Co., Ram Nagar, New Delhi, 26th edition, 2018.
2. Hibbeler, R.C., "Mechanics of Materials ", 9th edition, 2013
3. Subramanian R., "Strength of Materials", Oxford University Press, 3rd edition, 2016

Additional References:

1. nptel.ac.in/courses/Web course contents/.../strength%20of%20materials/homepage.htm
2. http://em2.yolasite.com/

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)ProgrammeSpecific Outcomes(PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	3	3	1									2	1	
CO 2	3	3	3	1									2	1	
CO 3	3	3	3	1									2	1	
CO 4	3	3	3	1									2	1	
CO 5	3	3	3	1									2	1	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Totalmarks**
Remember	Online Quiz	5	15
Understand	Tutorial	5	
	Assignment	5	

Summative Assessment				
Bloom’s Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE–I (5)	**IAE–II (10)**	**IAE–III (10)**	
Remember				
Understand	20	20	20	40
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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23ME402	Thermal Engineering	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Prerequisites	Engineering Thermodynamics				

Course Objectives

The course is intended to

1. Use the concepts, laws, and methodologies from the first course in thermodynamics into the analysis of cyclic processes
2. Construct the various parts of IC engines in thermal applications.
3. Select the steam boilers, their mountings and accessories according to its working principle.
4. Justify the shape of nozzles based on the required performance in the steam turbines.
5. Compare the vapour compression and vapour absorption refrigeration systems.
6. Integrate the thermodynamic and psychometric processes in the air conditioning systems.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO 1	Implement the thermodynamic concepts to different air standard cycles and solve problems.	Apply
CO 2	Demonstrate the I.C. engine components, actual and theoretical P-V diagram, valve and port timing diagram of two-stroke and four-stroke engines.	Apply
CO 3	Select the low and high-pressure boilers and its mountings based on its construction and operation.	Apply
CO 4	Compare the impulse and reaction turbines based on the shapes and functions of the steam nozzle.	Analyse
CO 5	Differentiate the operation and principle of thermal cooling systems used in refrigeration and air-conditioning systems.	Analyse

Course Contents

Module-I Gas Power Cycles **9**

Introduction - Air Standard Cycles – Assumptions, Otto, Diesel, Dual, and Brayton – Cycle Performance Analysis and Comparisons.

Module-II Internal Combustion Engines **9**

IC engine Classification, components, and functions. P-V diagram - Valve and port timing diagram, Two-stroke, and four-stroke engines - Petrol and diesel engine – Ignition, Fuel injection system, Cooling systems

Module-III Steam Boilers **9**

Classification of steam boilers - Difference between fire tube and water tube, low pressure and high-pressure boilers - super-critical boiler - Boiler mountings and accessories

Module-IV Steam Nozzles and Steam Turbines **9**

Nozzles and their shapes, Friction in a nozzle, Maximum discharge through a nozzle. Introduction - Classification of steam turbines, compounding.

Module-V Refrigeration and Air Conditioning systems **9**

Refrigeration systems - Vapour compression, vapour absorption system- Comparison - Simple air-conditioning cycle- working principle of the air-conditioning system.

Total: 45 Periods

Text Books

1. Arora.C.P, "Refrigeration and Air conditioning", McGraw Hill publication, 4th edition, 2021
2. R.S.Khurmi and J.K.Guptha, "Thermal Engineering", 15th Edition, S.Chand publisher, 2013

Reference Books

1. Rajput, "Thermal Engineering", Laxmi Publications, 10th edition, 2018
2. C.P.Kothandaraman, S.Domkundwar and A.V.Domkundwar, "A course in Thermal Engineering", Dhanpat Rai & Sons, 2014.
3. Rudramoorthy R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003.

Additional References:

1. https://ocw.mit.edu/courses/mechanical-engineering/
2. http://nptel.ac.in/courses/112104033/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	2	3	2										2	3	
CO 2	2	3	2										2	3	
CO 3	2	3	2										2	3	
CO 4	2	3	2										2	3	
CO 5	2	3	2										2	3	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Understand	Online Quiz	5	15
Apply	Tutorial Class / Assignment	5	
	Attendance	5	

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Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (100)
	IAE – I (5)	IAE – II (10)	IAE – III (10)	
Remember				
Understand	20	20	20	40
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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23ME403	Manufacturing Technology - II	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Manufacturing Technology-I				

Course Objectives

The course is intended to

1. List and outline the various metal removal processes.
2. Gain knowledge on various operations of lathe machine.
3. Demonstrate the process of making special components using special purpose machines.
4. Expose the students to various advanced super finishing processes.
5. Recognize the basic concept and various types of broaching machines
6. Examine the basic concepts of rapid prototyping and tooling technology and its applications.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Recall the mechanism of material removal processes	Understand
CO 2	Demonstrate the Constructional and operational features of special purpose machines.	Remember
CO 3	Identify the operational features of advanced super finishing Processes and Broaching machines	Apply
CO 4	Describe the types of computer numerical control machines and Basic concepts of CAD/CAM technology.	Apply
CO 5	Apply the appropriate tooling for rapid prototyping process	Apply

Course Contents

Module – I Theory of metal cutting **9**

Types of metal cutting processes: Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools- nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

Module – II Special Purpose Machines **9**

Shaper – Types of operations. Drilling Machine, reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes -finishing of gears.

Module – III Advanced Super finishing Technology **9**

Abrasive processes: grinding wheel — specifications and selection, types of grinding process-cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications. Introduction, Lapping, Horning, Buffing, Barrel Tumbling, Burnishing, Powder coating, Polishing. Broaching machines: broach construction — push, pull, surface and continuous broaching machines

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Module – IV **Computer Numerical Controlled Machines** **9**

Numerical Control (NC) machine tools — CNC types, constructional details, special features, machining centre, part programming fundamentals CNC — manual part programming. Basic concepts of CAD/CAM and their Integration Tools

Module – V **Rapid prototyping and Tooling** **9**

Introduction to Rapid Prototyping & Rapid Tooling, Green manufacturing. Challenges to manufacturing technology- evolution of precision in manufacturing, tooling and current scenario, requirements and applications

Total : 45 Periods

Text Books

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters 2014
2. SeropeKalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson publication, Singapure, 4th edition, 2014.
3. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 4thEdition, 2018.

Reference Books

1. R.K. Jain, "Production Technology" Khanna Publishers, New Delhi, 2015.
2. Rajput, R.K., "A Textbook of Manufacturing Technology", Laxmi publications Ltd, New Delhi, 2nd edition, 2017.
3. Rapid prototyping: Principles and applications, second edition, Chua C.K., LeongK.F., and Lim C.S., World Scientific Publishers, 2003.

Additional References

1. https://nptel.ac.in/courses/112/105/112105126/
2. https://nptel.ac.in/courses/112/104/112104204/
4. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-me03/

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and ProgrammeSpecific Outcomes (PSO's)														
COs	**PO's**												**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	1	1			1	1	1					1	3
CO 2	3	1	1			1	1	1					1	3
CO 3	3	1	1			1	1	1					1	3
CO 4	3	1	1			1	1	1					1	3
CO 5	3	1	1			1	1	1					1	3
	3-High				**2-Medium**				**1- Low**					

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Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE) (40)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**(100)**
Remember	20	10	10	20
Understand	20	20	10	20
Apply	10	20	30	60
Analyse				
Evaluate				
Create				

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23EE409	Electrical Drives and Control	L	T	P	C
		3	0	0	3
Nature of course	Engineering Sciences				
Pre requisites	Basics of Electrical and Electronics Engineering				

Course Objectives

The course is intended to

1. Learn steady state operation and transient dynamics of a motor load system
2. Study the different methods of starting and characteristics of drive motors
3. Learn the conventional speed control concepts of drive motors
4. Know solid state control of drive motors
5. Learn the industrial applications in drive motor control.
6. Relate the concept of AC and DC drives with its applications.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO1	Summarize the basic drive system and inter prelit for different types of loads.	Understand
CO2	Show the motor situation during starting and braking.	Understand
CO3	Develop control circuitry and devices for control of motor.	Apply
CO4	Construct the circuit for control purpose along with its different configuration.	Apply
CO5	Develop the Digital control system for drive applications.	Apply

Course Contents

Module –I	Introduction	9
Basic elements-types of electric drives-factors influencing electric drives-heating and cooling curves loading conditions and classes of duty-Selection of power rating for drive motors with regard to thermal overloading and load variation factors		
Module –II	**Drive motor characteristics**	**9**
Mechanical characteristics- speed- torque characteristics of various types of load and drive motors - braking of electrical motors-dc motors: shunt, series, compound motors-single phase and three phase induction motors		
Module–III	**Starting methods**	**9**
Types of d.c motor starters-typical control circuits for shunt and series motors-three phase squirrel and slip ring induction motors		
Module–IV	**Conventional and solid-state speed control of D.C Drives**	**9**
Speed control of DC series and shunt motors-Armature and field control, ward-Leonard control system using controlled rectifiers and DC choppers –applications		
Module–V	**Conventional and solid-state speed control of AC drives**	**9**
Speed control of three phase induction motor-Voltage control, voltage/frequency control, slip power recovery scheme-using inverters and AC voltage regulators-applications		
		Total: 45 Periods

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Text Books

1. J.Gnanavadivel,"ElectricalDrivesandControl",AnuradhaPublications,2004.
2. Vedam Subramaniam "Electric drives (concepts and applications)", Tata McGraw-Hill,2001
3. G.K.Dubey,"PowerSemiconductorControlledDrives",PrenticeHallInternational,1989.

Reference Books

1. WernerLeonhard,"ControlofElectricalDrives",Springer(India)Pvt.Ltd.,2006.
2. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education,2015.
3. IonBoldea and S. A.Nasar, "Electric Drives", CRC Press LLC, NewYork, 3rd edition, 2016.

Web References

1. http://electrical-engineering-portal.com/download-center/books-and-guides/siemens-basics-ofenergy/basics-of-dc-drives.
2. https://www.joliettech.com/products/dc-variable-speed-drives/dc-drive-fundamentals/

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2			3							2		3
CO 2	3	2			3							2		3
CO 3	3	2			3							2		3
CO 4	3	2			3							2		3
CO 5	3	2			3							2		3
	3-High				2-Medium				1- Low					

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class/Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE I(5)	IAE II(10)	IAE III(10)	
Remember	10	10	10	20
Understand	20	20	10	40
Apply	20	20	30	40
Analyze				
Evaluate				

23MA402	STATISTICAL AND NUMERICAL METHODS (Common to Aero, Agri, Civil, Food, Mech, PCT & S&F)	L	T	P	C
		3	0	2	4
Nature of Course	Basic Sciences				
Pre requisites	Foundations of Mathematics				

Course Objectives

The course is intended to

1. Acquaint with the knowledge of testing of hypothesis for small and large samples
2. Familiarize with the basic concept on types of design of experiments used in the field of engineering
3. Introduce the basic concepts of algebraic and transcendental equations.
4. Acquire the concept of numerical techniques of differentiation and integration.
5. Study the numerical techniques in solving ordinary differential equations.
6. Equip student with the ability to analyze data and solve mathematical problems using Statistical techniques and numerical algorithm.

Course Outcomes

On successful completion of the course, students will be able to

CO1	Interpret the testing of hypothesis for small and large samples.	Apply
CO2	Explain the basic concepts of classifications of design of experiments in the field of engineering.	Apply
CO3	Demonstrate the algebraic and transcendental equations.	Apply
CO4	Apply the numerical techniques of interpolation and error approximations in various intervals in real life situations.	Apply
CO5	Execute the numerical techniques for solving first and second order ordinary differential equations.	Apply
CO6	Create new statistical techniques and numerical algorithms for data analysis and problem solving.	Apply

Course Contents:

Module – I	**TESTING OF HYPOTHESIS**	**9**
Sampling distributions – Estimation of parameters – Statistical hypothesis – Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t for single mean and difference of means, Chi-square - Contingency table (test for independent) -Goodness of fit.		
Module – II	**DESIGN OF EXPERIMENTS**	**9**
One way and two way classifications – completely randomized design – Randomized block design – Latin square design.		
Module – III	**SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS**	**9**
Solution of linear system of equations – Gauss elimination method – Gauss Jordan method - Iterative methods of Gauss Jacobi method and Gauss Seidel method– Eigen values of a matrix by Power method		

Module – IV	INTERPOLATION AND NUMERICAL INTEGRATION	9
Lagrange's interpolations - Newton's divided difference interpolations – Newton's forward difference and backward difference formulae – Numerical integration using Trapezoidal and Simpson's 1/3 rules.		
Module – V	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9**
Single step methods: Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations – Multi step methods: Milne's predictor corrector methods for solving first order equations.		
		Total: 60 Periods

Text Books:

1. Gupta S.C and Kapoor V.K., Fundamentals of Mathematical Statistics", Sultan chand & sons, New Delhi, 12th Edition, 2020
2. Grewal B.S, and Grewal J.S " Numerical methods in engineering and science "Khanna Publishers, 10th Edition, 2015.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference Books:

1. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, New Delhi, 3rd Edition, 2017
2. Burden, R.L and Faires, J.D, "Numerical Analysis", Cengage Learning, 9th Edition, 2016.
3. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, 8th Edition, 2016.

Additional References:

1. https://pvpsitrealm.blogspot.com/2016/09/higher-engineering-mathematics-by-bs.html
2. https://reference.wolfram.com/language/tutorial/Numerical methods.html
3. https://www.researchgate.net/publication/349657530_Statistics_and_Numerical_Methods

Laboratory Components using MATLAB:

S.No	List of Experiments	CO Mapping	RBT
1	Student's t - test	1	Apply
2	Chi – Square test	1	Apply
3	One way classification	2	Apply
4	Two way classification	2	Apply
5	Gauss Elimination Method	3	Apply
6	Gauss Seidel Method	3	Apply

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7	Lagrange's Interpolation Formula	4	Apply
8	Simpson's 1/3 rd rule	4	Apply
9	Euler's Method	5	Apply
10	Runge – Kutta Method	5	Apply

Total: 30 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	2		
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2		
CO3	3	3	1	-	-	-	-	-	-	-	-	-	1		
CO4	2	2	2	-	-	-	-	-	-	-	-	-	2		
CO5	3	3	2	-	-	-	-	-	-	-	-	-	2		
CO6	3	2	3	-	-	-	-	-	-	-	-	-	2		
	3	High				2	Medium					1	Low		

Bloom's Level	Summative Assessment						
	Continuous Assessment						Final Examination (Theory) [50]
	Theory			Practical			
	IAE I (5)	IAE II (10)	IAE III (10)	Attendance [5]	Rubric based [10]	Model Exam [10]	
Remember	10	10	10				10
Understand	10	10	10		40	40	30
Apply	30	30	30		60	60	60
Analyze							
Evaluate							
Create							

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20ME404	Engineering Metrology	L	T	P	C
		3	0	2	4
Nature of course	Professional Core				
Pre requisites	Physics for Mechanical Sciences				

Course Objectives

The course is intended to

1. Demonstrate the basics of measurement system and experimental errors.
2. Introduce the linear, angular and optical measuring instruments.
3. Impart knowledge on fits, tolerances and gauges design.
4. Determine with surface roughness measurement.
5. Examine the measurement of Displacement, Stress and Strain, and Force and Torque.
6. Use the measurement techniques of Pressure, Fluid flow and Temperature.

Course Outcomes

On successful completion of the course, students will be able to

CO.No	Course Outcome	Bloom's Level
CO1	Identify the fundamentals concepts of Measuring system and Errors in Measurement.	Understand
CO2	Apply the principles of linear and angular measurement tools in Industrial applications.	Apply
CO3	Demonstrate the working procedure of Laser Interferometer and Coordinate Measuring Machine (CMM).	Apply
CO4	Discover the techniques of form measurement used for industrial Components.	Apply
CO5	Choose the various measuring instruments used to measure the power, Flow and temperature.	Apply

Course Contents

Module – I Basics of Metrology **9**

Introduction to Metrology - Need - Elements - Work piece, Instruments -Terms associated with measurement: sensitivity, readability, reliability and repeatability - Errors in Measurements - Types - Control – Types of standards.

Module – II Linear and angular Measurements **9**

Linear Measuring Instruments – Limit gauges – gauge design – terminology -concepts of interchangeability and selective assembly - Angular measuring instruments - Bevel protractor clinometers angle gauges, spirit levels sine bar - Angle alignment telescope - Autocollimator.

Module – III Advances in Metrology **9**

Basic concept of lasers Advantages of lasers - laser Interferometers - types - DC and AC Lasers interferometer - Applications - Straightness - Alignment. Basic concept of Coordinate Measuring Machine (CMM), Machine Vision System.

Module – IV Form Measurements **9**

Principles and Methods of straightness measurement, Flatness measurement, Thread measurement, gear measurement, surface finish measurement, Roundness measurement -Applications.

Module – V Measurement of power, flow and temperature **9**

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube - Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration.

Total: 45 Periods

Laboratory Component

S.No.	Name of the Experiment	CO Mapping	RBT
1	Calibration of Vernier caliper and screw gauge	CO1	Apply
2	Calibration of Vernier height gauge	CO1	Apply
3	Calibration of depth micrometer and bore gauge	CO2	Apply
4	Measurement of angles using bevel protractor	CO2	Apply
5	Calibration using sine bar	CO3	Apply
6	Measurement of gear parameters	CO3	Apply
7	Measurement of surface finish (machined)	CO4	Apply
8	Measurement of surface finish (polished)	CO4	Apply
9	Measurement of force and torque	CO5	Apply
10	Measurement of temperature	CO5	Apply

Total: 30 Periods

Text Books

1. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, 6th edition 2020.
2. Gupta.I.C.,“Engineering Metrology”, Dhanpatrai Publications, 6th edition 2018.

Reference Books

1. Charles Reginald Shotbolt, “Metrology for Engineers”, Cengage Learning EMEA, 5th edition1990.
2. Raghavendra, Krishnamurthy “Engineering Metrology & Measurements”, Oxford university press, 2016.
3. Jain R.K.“Engineering Metrology”, Khanna Publishers, 2021.

Additional / Web References

1. https://www.mek.dtu.dk/english/Sections/MPP/Research/Manufacturing-metrology
2. https://tint.edu.in/tict-me-dept-laboratories/metrology-measurement-lab.html
3. http://www.metrology.wat.edu.pl/index.php/links/

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3			2								1	1	3	
CO2	3			2								1	1	3	
CO3	3			2								1	1	3	
CO4	3			2								1	1	3	
CO5	3			2								1	1	3	
	3	High				2	Medium					1	Low		

Summative assessment						
Bloom's Level	**Continuous Assessment**					**Final Examination (Theory) [100marks]**
	Theory				**Practical**	
	IAE –I [5]	**IAE –II [10]**	**IAE –III [10]**	**Attendance [5]**	**Rubric based CIA [20Marks]**	
Remember	20	20	10		20	20
Understand	30	20	20		20	20
Apply		10	20		40	60
Analyse						
Evaluate						
Create						

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23ME405	Thermal Engineering Laboratory	L	T	P	C
		0	0	2	1
Nature of course	**Professional Core**				
Prerequisites	Engineering Thermodynamics and Thermal Engineering				

Course Objectives

The course is intended to

1. Evaluate the various performance tests on IC Engines
2. Study the value timing and port timing diagram of four-stroke and two-stroke engines
3. Determine the flash point and fire point of various oils and lubricants.
4. Analyse the air compressor and blower performance and factors influencing its performance
5. Examine the performance of refrigeration cycle and air conditioning systems.
6. Use the properties of moist air and its application in air conditioning systems.

Course Outcomes

On successful completion of the course, students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Evaluate the various performances of I.C. engines.	Apply
CO 2	Construct the valve timing and port timing diagram, along with the working principle and combustion process of IC engine.	Apply
CO 3	Determine the flash point and fire point of various oils and lubricants.	Apply
CO 4	Explain the working of the air compressor and air blower along with factors influencing its performance	Apply
CO 5	Compute the cooling load for air conditioning and COP of refrigeration systems.	Apply

S. No	List of Experiments	CO Mapping	Revised Blooms Taxonomy
1.	Performance test on 4 - stroke Diesel Engine.	CO 1	Apply
2.	Heat balance test on 4 - stroke Diesel Engine.	CO 1	Apply
3.	Retardation test to find Frictional Power of a Diesel Engine.	CO 1	Apply
4.	Valve timing diagram of a 4-stroke Diesel Engine	CO 2	Apply
5.	Port timing diagram of a 2-stroke Petrol Engine	CO 2	Apply
6.	Determination of flash point and fire point of various oils/lubricants.	CO 3	Apply
7.	Performance test on two stage reciprocating air Compressor	CO 4	Apply
8.	Viscosity measurement using redwood Viscometer	CO 4	Apply
9.	Performance test on air conditioning System	CO 5	Apply
10.	Determination of COP of a refrigeration system	CO 5	Apply

Total : 30 Periods

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	3	3										1	3	
CO 2	3	3	3										1	3	
CO 3	3	3	3										1	3	
CO 4	3	3	3										1	3	
CO 5	3	3	3										1	3	
	3	High				2	Medium					1	Low		

Assessment based on Continuous and Final Examination			
Bloom's Level	**Continuous Assessment (60 marks) (Attendance – 5 marks)**		**Final Examination [40 marks]**
	Rubric based Continuou Assessment [30 marks]	**Model Examinatio [25 marks]**	
Remember			
Understand			
Apply	100	100	100
Analyze			
Evaluate			
Create			

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23ME406	Manufacturing Technology Laboratory- II	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Manufacturing Technology - I				

Course Objectives

The course is intended to

1. Examine the knowledge on various basic machining operations in special purpose Machines and its applications in real life manufacture of components in the industry.
2. Analyse the objectives and emphasize the importance of manufacturing Sciences in the day-to-day life.
3. Examine the conventional manufacturing processes using lathe and various special purpose machines.
4. Identify the various machine tools and its working principles for various engineering applications.
5. Apply the design of machine tool structures and special features of machine tool design.

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
CO 1	Examine the various lathe operations.	Apply
CO 2	Perform the various machining operations in drilling machines.	Apply
CO 3	Choose different machine tools for manufacturing gears.	Apply
CO 4	Utilize different machine tools for surface finishing and tool grinding operations.	Apply
CO 5	Select a suitable process for making key holes.	Apply

S.No	List of Exercises	CO Mapping	Blooms Taxonomy
1	Facing and Step turning in lathe machine.	CO1	Apply
2	Lathe - Taper turning and Thread cutting processes.	CO1	Apply
3	Drilling Machine - Drilling, Reaming processes.	CO2	Apply
4	Drilling Machine - Boring and Tapping processes.	CO2	Apply
5	Contour milling using vertical milling machine.	CO3	Apply
6	Spur and Helical Gear Cutting in milling machine.	CO3	Apply
7	Grinding components using cylindrical and centerless grinding machine.	CO4	Apply
8	Grinding of cutting tools using tool and cutter grinder.	CO4	Apply
9	Machining key hole in a slotting machine.	CO5	Apply
10	Machining slot using a shaping machine.	CO5	Apply
			Total: 60 Periods

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	1		2				1	1		1	1	3	
CO 2	3	2	1		2				1	1		1	1	3	
CO 3	3	2	1		2				1	1		1	1	3	
CO 4	3	2	1		2				1	1		1	1	3	
CO 5	3	2	1		2				1	1		1	1	3	
	3-High				**2-Medium**				**1-Low**						

Summative Assessment			
Bloom's Level	**Continuous Assessment (60 marks) (Attendance – 5 marks)**		**Final Examinatio [40 marks]**
	Rubric base Continuous Assessment [30 marks]	**Model Examinatio [25 marks]**	
Remember			
Understand	20	20	20
Apply	80	80	80
Analyse			
Evaluate			
Create			

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Mandatory Course

23MC202	ENVIRONMENTAL SCIENCES (Common for all branches)	L	T	P	C
		2	0	0	0
Nature of Course	Mandatory, Non Credit				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Understand the concept of eco system and environment.
2. Become conversant with ecological balance and values of biodiversity.
3. Know the role of human in prevention of pollution and making a clean environment.
4. Get knowledge about conservation of non-conventional energy resources.
5. Study about the nature and management of e-waste and solid waste.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Explain the knowledge about ecosystem and environment	Understand
CO 2	Interpret the ecological balance and preservation of bio diversity	Understand
CO 3	Demonstrate various types of pollution in order to control pollution	Apply
CO 4	Classify the energy sources for the conservation of non conventional energy sources	Understand
CO 5	Identify the nature and management of e-waste and solid waste	Apply

Course Contents

Module – I	ECOSYSTEM	6
Eco system - Food chains, Food webs and Ecological pyramids. Ecosystem (a) Forest eco system, (b) Aquatic eco system (pond ecosystem and marine ecosystem).		
Module – II	**BIODIVERSITY**	**6**
Introduction to Bio diversity, Values of Bio diversity, Threads to Bio diversity, Endangered and Endemic species of India, Hotspots of biodiversity. Conservation of Biodiversity: In-Situ and Ex-Situ conservation of biodiversity.		
Module – III	**ENVIRONMENTAL POLLUTION**	**6**
Definition, Causes, Effects and Control of (a) Air pollution (b) Water pollution (c) Soil pollution. Electrostatic Precipitator for controlling air pollution.		
Module – IV	**NON-CONVENTIONAL ENERGY RESOURCES**	**6**
Introduction, Types, Working and Applications of: Solar Energy- Photovoltaic (PV) solar energy, Wind Energy-Onshore wind power- and Geo Thermal Energy-Geo thermal power plant.		

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Module – V	ENVIRONMENTAL MANAGEMENT	6
Sustainable Development, Waste Management: Types, sources and disposal of municipal, industrial solid Waste, Role of Information technology in Environment and Human. COVID-19 and JN-1 Virus.		
		Total : 30 Periods

Activity Components

S.No	List of Experiments	CO Mapping	RBT
1	Field study of simple eco system: pond, river and hill slopes	CO1	Understand
2	Case study regarding environmental management	CO5	Apply

Text Books

1. AnubhaKaushik and C.P. Kaushik, "Environmental Science and Engineering, New Age International Publishers, New Delhi, 2nd Edition, 2019.
2. V. Kumar, "An Introduction to Green Chemistry" Vishal publishing Co. Reprint Edition, 2020.

Reference Books

1. Santosh Kumar Garg and Rajeshwari Garg "Ecological and Environmental Studies", Khanna Publishers, Nai Sarak, Delhi, 2nd Edition, 2019.
2. Masters, Gilbert M, "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi, 2nd Edition, 2020.

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1. https://nptel.ac.in/courses/122103039/38
2. https://bch.cbd.int/cms/ui/collaboration/download/download.aspx?id=909
3. https://nptel.ac.in/courses/105102089/air%20pollution%20(Civil)/Module-3/3a.htm
4. www.vssut.ac.in/lecture_notes/lecture1428910296.pdf
5. nptel.ac.in/courses/120108004/module7/lecture8.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1		3					1					3		
CO 2		3					3					1		
CO 3		3					2					3		
CO 4		2					3					2		
CO 5		3					3					2		
	3-High				2-Medium				1-Low					

Passed in Board of Studies Meeting on 28.12.2023 *Passed in Academic Council Meeting on*

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Summative Assessment					
Bloom's Level	Continuous Assessment				
	IAE-I [20]	IAE-II [20]	IAE-III [20]	Attendance [20]	Activity [20]
Remember	20	20	15		
Understand	30	25	25		
Apply		5	10		
Analyze					
Evaluate					
Create					

23MC003	INTERPERSONAL SKILLS (Common to all B.E. / B.Tech Programme)	L	T	P	C
		0	0	2	0
Nature of Course	Mandatory – Non Credit				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Evaluate current relationships and their communication style.
2. Identify ways for improving important relationships.
3. Explore how the Bible correlates with principles from the chapter.
4. Describe how the communication processes impacts our ability to effectively communicate.
5. Identify challenges that may arise from interpersonal communication.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Practice interpersonal communication skills to influence and build good relationships.	Remember
CO 2	Identify and pursue personal learning goals.	Understand
CO 3	Give evident feedback.	Apply
CO 4	Reveal group dynamics and amiable behaviour.	Apply
CO 5	Emphasis the communication process.	Understand

Course Contents

Module – I	**FUNDAMENTALS OF INTERPERSONAL COMMUICATION**	**6**
Facts of communication and Interpersonal communication - culture and gender - Communication and Self disclosure - Presentation of Interpersonal perception - Learning goals - Feeling and feedback.		
Module – II	**INTERPERSONAL COMMUNICATION IN ACTION**	6
Nature of language - language and culture - usage and abuse of language -Positive communication -Non verbal communication - Listening strategies - Barriers of listening.		
Module – III	**EMOTIONAL INTELLIGENCE**	6
Influence of emotional experience and expressions - Accepting the responsibilities and changes - Negotiation tactics - Dealing with criticism and appreciation - Collaborative Problem Solving - Resilience Building.		
Module – IV	**TRANSACTIONS**	6
Different types of transactions - Building Positive Relationship - Managing Conflict - Connecting across Difference -Factors hampering Interpersonal interactions - Assertiveness in communication.		

Module – V	**ESSENTIAL INTERPERSONAL COMPETENCIES**	6
Behaviour - understanding limiting behaviour - Interpersonal and small and lateral thinking-Win -Win attitude - Positive thinking - Stress feedback - Personal Evaluation of Interpersonal Relationship Skills group behavior - Critical management - Assertive		
		Total : 30 Periods

Text Books

1. Bozeman, Jeanine C and Argile Smith, "Interpersonal Relationship Skills for Ministers" Gretna, LA: Pelican Publishing Company, 1st Edition, 2004.
2. Floyd, Kory, "Interpersonal Communication", 2d. Boston: Mccraw-Hill, 2nd Edition, 2011.

Reference Books

1. Augsburger, David, "Caring Enough to Confront How to Understand and Express Your Deepest Feelings Towards Others", updated ed Ventura, CA: Regal Books, 2nd Edition 2009.
2. Vohs, Kathleen D., and Eli J., Finkel, eds, "Self and Relationships: Connecting Intrapersonal and interpersonal Processes". New York Guilford Press, 1st Edition, 2006.

Web References:

1. https://nptel.ac.in/courses/111104031
2. https://nptel.ac.in/courses/111106139
3. https://nptel.ac.in/courses/111105134

Laboratory Components:

S.No	List of Experiments	CO Mapping	RBT
1	Presentation of Interpersonal Perception	1	Remember
2	Non-Verbal Communication	2	Understand
3	Negotiation tactics	3	Apply
4	Managing Conflict	4	Apply
5	Stress Management	5	Understand

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)														
COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1										3	2	1	2	
CO 2										3	2	1	2	
CO 3										3	2	1	2	
CO 4										3	2	1	2	
CO 5										3	2	1	2	
	3-High				**2-Medium**				**1-Low**					

Bloom's Level	**Summative Assessment (Internal Mode)**	
	Assessment 1 (50 Marks)	**Assessment 2 (50 Marks)**
Remember	20	20
Understand	10	10
Apply	20	20
Analyse		
Evaluate		
Create		

23MC004	INDIAN CONSTITUTION (Common to all B.E. / B.Tech Programme)	L	T	P	C
		2	0	0	0
Nature of Course	Mandatory Course				
Pre requisites	Fundamentals of Indian Constitution				

Course Objectives

The course is intended to

1. Know about the basic structure with the key elements of the Indian Constitution.
2. Enable students to grasp the Fundamental Rights, Directive Principles of State Policy and Fundamental Duties of our constitution.
3. Promote the students about our Union Government, political structure and their functions.
4. Prepare the students with the Indian judiciary and Election systems.
5. Learn the State Legislature, State politics and State planning commission in India.
6. Study the powers and functions of various constitutional offices and institutions.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Utilize the basic structure of Indian Constitution in real life situation.	Understand
CO 2	Relate their Fundamental Rights, DPSP's and Fundamental Duties (FD's) of our constitution.	Understand
CO 3	Compare the Union Government, political structure and their powers and functions.	Understand
CO 4	Outline about our Indian Judiciary, Election Commission and Amendments.	Understand
CO 5	Summarize the power and functions of State Legislature.	Understand
CO 6	Realise the significance of the constitution and appreciate the role of constitution and citizen oriented measures in a democracy.	Understand

Course Contents

Module – I	INTRODUCTION TO INDIAN CONSTITUTION	6
The Historical background - Meaning of the term Indian Constitution - Necessity of the Constitution - Societies before and after the Constitution adoption - Introduction to the Indian constitution - Making of the Constitution, Role of the Constituent Assembly.		
Module – II	**FUNDAMENTAL RIGHTS**	**6**
Salient features of India Constitution - Preamble of Indian Constitution & Key concepts of the Preamble - Fundamental Rights (FR's) - its Restriction and limitations in different Complex Situations - Directive Principles of State Policy - its present relevance in Indian society - Fundamental Duties - its Scope and significance in Nation.		

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Module – III	UNION GOVERNMENT	6
Union Government – Union legislature – Lok sabha – Rajya sabha (with powers and functions) -Union Executive – President (with powers and functions), Prime Minister (with powers and functions), Union Cabinet.		
Module – IV	**INDIAN JUDICIARY AND ELECTION COMMISSION**	**6**
Structure of Judicial System in India - Supreme Court - High Courts - District Courts - Role of Judiciary in India - Judicial Reviews and Judicial Activism. Elections & Electoral Process. Amendment to Constitution, and Important Constitutional Amendments till today.		
Module – V	**STATE LEGISLATURE**	**6**
Organization and Composition of State Legislature - Legislative Council - Composition of the Council - Composition of the Assembly - Qualifications for the Houses - Legislative Assembly - Duration of State Legislature - Duration of Assembly - Duration of Council.		
		Total : 30 Periods

Text Books

1. Durga Das Basu, Introduction to the Constitution of India, Gurgaon; LexisNexis, (23rd edn.) 2018
2. J.N. Pandey, The Constitutional Law of India, Allahabad; Central Law Agency,(55th edn.) 2018.
3. P.M Bakshi, Constitution of India, Universal Law Publishing House, NewDelhi, 1999.

Reference Books

1. Constitution of India, Professional Ethics and Human Rights" by Shubham Singles, Charles E. Haries, and et al: published by Cengage Learning India, Latest Edition – 2019.
2. KB Merunandan, Bharatada Samvidhana Ondu Parichaya, Bangalore, Meragu Publications, 2015
3. K.Sharma, Introduction to the Constitution of India, Prentice Hall of India, NewDelhi, 2002.

Web References:

1. https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf.
2. https://edukemy.com/blog/upsc-ncert-notes-indian-polity-state-legislature/#Organization_and_Composition_of_State_Legislature
3. https://blog.ipleaders.in/dpsp-and-fundamental-rights/

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1								1				1		1
CO 2								1				1		1
CO 3								1				1		1
CO 4								1				1		1
CO 5								1				1		1
	3-High				2-Medium				1-Low					

Formative assessment			
Bloom's Level	Continuous Assessment (IAE)		Total marks
	Assessment component	Marks	
Remember	Online Quiz	20	50
Understand	Tutorial class/Assignment	25	
	Attendance	5	

Summative assessment			
Bloom's Level	Continuous Assessment (IAE)		
	Theory Marks		
	IAE-I [10]	IAE-II [20]	IAE-III [20]
Remember	20	10	10
Understand	30	20	20
Apply		20	20
Analyse			
Evaluate			
Create			

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23MC005	YOGA AND VALUES FOR HOLISTIC DEVELOPMENT (Common to all B.E. / B.Tech Programme)	L	T	P	C
		0	0	2	0
Nature of Course	Mandatory Course				
Pre requisites	Fundamentals of Yoga				

Course Objectives

The course is intended to

1. Know the various types of yoga and their benefits.
2. Practice essential yoga postures and techniques.
3. Give mental clarity and focus through the practice of pranayama.
4. Incorporate relaxation technique into their daily routine works.
5. Use meditation to reduce stress and anxiety.
6. Promote positive health, prevention of stress related health problems and rehabilitation through Yoga.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Balance their full potential and confidence.	Understand
CO 2	Understand the knowledge of fundamental yoga postures.	Understand
CO 3	Realize the enhanced the functions of inner organs.	Understand
CO 4	Achieve a deep state of relaxation and release physical and mental tension.	Understand
CO 5	Cultivate a sense of calm and well-being.	Understand
CO 6	Experience enhanced flexibility, strength and balance as well as reduced stress.	Understand

Course Contents

Module – I	INTRODUCTION TO YOGA	6
Foundations of Yoga - History and Development of Yoga - Etymology and Definitions, Misconceptions, Aim and Objectives of Yoga, True Nature and Principles of Yoga - Introduction to Vedas – Upanishads - Prasthanatrayee - Purushartha Chatushtaya.		
Module – II	**POSTURES (ASANA)**	**6**
Trikonasana - Ardha-Kati – Chakrasana – Tadasana - Vrikshasana - Padmasana, Simhasana - Paschimottanasana, Uttanpadasana – Salabhasana - Shavasana Pawanmuktasana - Anti-Rheumatic Series - Digestive / Abdominal Group - Energy Bock Series - Back Strengthening Exercises - Sun Salutation (Surya Namaskar) - Classical Sequence.		
Module – III	**BREATHING**	**6**
The Foundations - Abdominal Breathing - Thoracic (mid-chest) breathing - Clavicular (upper chest breathing) - The Complete Yoga Breath. Pranayama Techniques - Breathing Ratios - Nadi Shodhana (Alternate Nostril Breathing) - Ujjayi (the 'whispering breath' or the 'psychic breath') - Bhramari (Humming Bee breath).		

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Module – IV	RELAXATION	6
Quick Relaxation techniques - Tense & Relax - Short Yoga Nidra (Power Nap) - Extended Shavasana - Yoga Nidra – Sankalpa.		
Module – V	**MEDITATION**	**6**
Develop a good, comfortable sitting posture - Kaya Sthairyam (Body Stillness) - Om Chanting - Trataka (Concentrated Gazing).		
		Total : 30 Periods

Text Books

1. Stephen Sturges, The Yoga Book. Motilal Banarsidass, Delhi, 2004.
2. Singh S.P & Yogi, Foundation of Yoga, Standard Publication, New Mukesh Delhi, 2010.
3. Sahay G.S. HathaYoga Pradeepika of Svatmarama, MDNIY Publication, 2013.

Reference Books

1. Bhat, Krishna K. The Power of Yoga: SuYoga Publications Mangalore,2006.
2. Fenerstein, George, The Yoga Tradition: It's History, Literature, Philosophy practice, Bhavana Books and Prints, 2002.
3. Tiwari, O.P, Asana Why and How? Kaivalyadhama, Lonavla, 2011.

Web References:

1. https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf.
2. https://edukemy.com/blog/upsc-ncert-notes-indian-polity-state-legislature/#Organization_and_Composition_of_State_Legislature
3. https://blog.ipleaders.in/dpsp-and-fundamental-rights/

Bloom's Level	Summative Assessment (Internal Mode)	
	Assessment 1 (50 Marks)	Assessment 2 (50 Marks)
Remember	10	10
Understand	10	10
Apply	30	30
Analyze		
Evaluate		
Create		

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23MC006	SOFT SKILLS (Common to all B.E. / B.Tech Programme)	L	T	P	C
		0	0	2	0
Nature of Course	Mandatory Course				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Improve language skills in personal and professional life.
2. Equip students with the vital communication and soft skills to succeed in the highly competitive international arena.
3. Focus on the fundamental soft skills and of their practical social and work place usage.
4. Learn to identify and overcome the barriers in interpersonal relationships.
5. Enhance employability skills and ensure career success.

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Relate the significance and fundamental nature of soft skills.	Remember
CO 2	Take part in a wide range of Public speaking and professional group discussions.	Understand
CO 3	Plan one's time effectively and productively, especially at work.	Apply
CO 4	Make use of leadership skills to manage stress &conflict.	Apply
CO 5	Organize presentation effectively and participate in interview with confidence.	Apply

Course Contents

Module – I	INTRODUCTION TO SOFT SKILLS AND INTERPERSONAL COMMUNICATION	6
An Introduction – Definition and Significance of Soft Skills; Interpersonal communication-types of interpersonal communication.		
Module – II	**PUBLIC SPEAKING AND ORAL COMMUNICATION SKILLS**	**6**
Public Speaking: Skills, Methods, Strategies Group Discussion: Importance, Planning, Elements.		
Module – III	**TIME MANAGEMENT AND PERSONALITY DEVELOPMENT**	**6**
Time Management – concepts and essentials tips. Personality-development – meaning, SWOT analysis & goal setting- Stress and conflict management.		
Module – IV	**LEADERSHIP SKILLS AND EMOTIONAL INTELLIGENCE**	**6**
Leadership skills: Concept of Leadership and honing Leadership Skills- Problem-Solving Skills - Group and Ethical Decision-Making. Emotional Intelligence: Strategies to enhance Emotional Intelligence.		

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Module – V	INTERVIEW SKILLS	6
Interviewer - Interviewee perspectives - Self Introduction and Presentation: Types, Content and Essential Tips–before, during and after a presentation, Overcoming Nervousness - Mock Interview.		
		Total : 30 Periods

Text Books

1. Managing Soft Skills for Personality Development–edited by B.N.Ghosh, McGraw Hill India, 2018.
2. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
3. English and Soft Skills–S.P. Dhanavel, Orient Black swan India, 2017.

Reference Books

1. Soft Skill Business and Professional Communication Book by Sutapa Banerjee,2016.
2. Communication Skills Book by PushpLata and Sanjay Kumar,2015.
3. Klaus, Peggy, Jane Rohman & Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.

Web References:

1. https://nptel.ac.in/courses/109/107/109107121/
2. https://onlinecourses.nptel.ac.in/noc22_hs77/preview
3. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1								1	2	3		2			
CO2								1	2	3		2			
CO3								1	2	3		2			
CO4								1	2	3		2			
CO5								1	2	3		2			
	3	High				2	Medium				1	Low			

Bloom's Level	Summative Assessment (Internal Mode)	
	Assessment 1 (50 Marks)	Assessment 2 (50 Marks)
Remember	10	10
Understand	10	10
Apply	30	30
Analyze		
Evaluate		
Create		

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M.E. Thermal Engineering

CURRICULUM AND SYLLABI

I to IV Semesters

Regulation - 2022

ENGINEERING COLLEGE

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KOMARAPALAYAM – 637303

DEPARTMENT OF MECHANICAL ENGINEERING
M.E - THERMAL ENGINEERING
REGULATION 2022
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTER CURRICULUM

I SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
22PMA105	Advanced Numerical Methods	FC	3	2	0	4	40	60	100
22PTE101	Advanced Heat Transfer	PC	3	0	0	3	40	60	100
22PTE102	Advanced Thermodynamics	PC	3	0	0	3	40	60	100
22PTE103	Advanced Fluid Mechanics	PC	3	0	0	3	40	60	100
22PTEEXX	Professional Elective I	PE	3	0	0	3	40	60	100
22PTEEXX	Professional Elective II	PE	3	0	0	3	40	60	100
Practical Course									
22PTE104	Thermal Engineering Laboratory	PC	0	0	4	2	50	50	100
TOTAL			**18**	**2**	**4**	**21**	**290**	**410**	**700**

II SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
22PTE201	Instrumentation for Thermal Engineering	PC	3	0	0	3	40	60	100
22PTE202	Fuels and Combustion	PC	3	0	0	3	40	60	100
22PTE203	Environmental Engineering and Pollution Control	PC	3	0	0	3	40	60	100
22PTE204	Design and Optimization of Thermal Energy Systems	PC	3	2	0	4	40	60	100
22PTEEXX	Professional Elective III	PE	3	0	0	3	40	60	100
22PTEEXX	Professional Elective IV	PE	3	0	0	3	40	60	100
Practical Course									
22PTE205	Thermal Systems Simulation Laboratory	PC	0	0	4	2	50	50	100
Employability Enhancement Course									
22PTE206	Technical Seminar	EEC	0	0	2	1	100	0	100
	TOTAL		**18**	**2**	**6**	**22**	**390**	**410**	**800**

III SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Courses									
22PEE301	Research Methodology and Intellectual Property Rights	PC	3	0	0	3	40	60	100
22TEEXX	Professional Elective V	PE	3	0	0	3	40	60	100
22TEEXX	Professional Elective VI	PE	3	0	0	3	40	60	100
Employability Enhancement Course									
22PTE301	Project Work Phase – I	EEC	0	0	12	6	50	50	100
TOTAL			**9**	**0**	**12**	**15**	**170**	**230**	**400**

IV SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Employability Enhancement Course									
22PTE401	Project Work Phase – II	EEC	0	0	24	12	50	50	100
TOTAL			**0**	**0**	**24**	**12**	**50**	**50**	**100**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 70

CREDITS SUMMARY

S. No	**CATEGORY**	**CREDITS PER SEMESTER**				**TOTAL CREDIT (AICTE)**	**CREDITS in %**
		I	**II**	**III**	**IV**		
1	FC	4				4	**5.714**
2	PC	11	15	3		29	**41.43**
3	PE	6	6	6		18	**25.71**
4	EEC		1	6	12	19	**27.14**
Total		**21**	**22**	**15**	**12**	**70**	**100%**

FC - Foundation Course
PC - Professional Core
PE - Professional Electives
EEC - Employability Enhancement Courses
MC - Mandatory Courses (Non-Credit Courses)
CA - Continuous Assessment
FE - Final Examination

LIST OF ELECTIVES FOR M.E THERMAL ENGINEERING SEMESTER I

Professional Elective I & II									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
22PTEE01	Thermal Management Systems of EV and HEV	PE	3	0	0	3	40	60	100
22PTEE02	Hydrogen and Fuel Cell Technologies	PE	3	0	0	3	40	60	100
22PTEE03	Energy Resources	PE	3	0	0	3	40	60	100
22PTEE04	Advanced Internal Combustion Engines	PE	3	0	0	3	40	60	100
22PTEE05	Advances in Metrology and inspection	PE	3	0	0	3	40	60	100
22PTEE06	Synthesis And Characterization Of Nano Materials	PE	3	0	0	3	40	60	100
22PTEE07	Polymers and Composite Materials	PE	3	0	0	3	40	60	100

LIST OF ELECTIVES FOR M.E THERMAL ENGINEERING SEMESTER II

Professional Elective III & IV									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
22PTEE11	Computational Fluid Dynamics for Thermal Systems	PE	3	0	0	3	40	60	100
22PTEE12	Fans, Blowers and Compressors	PE	3	0	0	3	40	60	100
22PTEE13	Food Processing, Preservation and Transport	PE	3	0	0	3	40	60	100
22PTEE14	Computational Heat Transfer	PE	3	0	0	3	40	60	100
22PTEE15	Air Conditioning Systems	PE	3	0	0	3	40	60	100
22PTEE16	Materials Testing and Characterization Techniques	PE	3	0	0	3	40	60	100
22PTEE17	Alternative Fuels for IC Engines	PE	3	0	0	3	40	60	100

LIST OF ELECTIVES FOR M.E THERMAL ENGINEERING SEMESTER III

Professional Elective V & VI									
Code No.	**Course**	**Category**	**Periods/ Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
22PTEE21	Advanced Power Plant Engineering	PE	3	0	0	3	40	60	100
22PTEE22	Advanced Thermal Storage Technologies	PE	3	0	0	3	40	60	100
22PTEE23	Cogeneration and Waste Heat Recovery Systems	PE	3	0	0	3	40	60	100
22PTEE24	Measurements in Thermal Engineering	PE	3	0	0	3	40	60	100
22PTEE25	Design of Heat Transfer Equipment	PE	3	0	0	3	40	60	100
22PTEE26	New & Renewable Sources of Energy	PE	3	0	0	3	40	60	100

SEMESTER- I

22PMA105	ADVANCED NUMERICAL METHODS	L	T	P	C
		3	2	0	4
Nature of Course	Foundation Course				
Pre requisites	Numerical Analysis in Thermal Science				

Course Objectives

The course is intended to

1. Numerical methods aided by technology to solve algebraic, transcendental and differential equations
2. Apply finite element methods for solving the boundary value problems in differential equations.
3. Develop problem solving skills in numerical integration and differential equations.
4. Understanding of the application of various methods in solving engineering problems.
5. Serve as a precursor for future research.

Course Outcomes

CO. No.	Course Outcome	Bloom's Level
CO1.	List the common numerical methods and how they are used to obtain approximate solutions	Remember
CO2.	Demonstrate the Eigen Value Problems And Curve Fitting	Understand
CO3.	Analyze and evaluate the accuracy of common numerical methods	Analyze
CO4.	Solve the numerical methods to obtain approximate solutions to Mathematical problems.	Apply
CO5.	Evaluate the numerical methods for various mathematical operations and tasks	Evaluate

Course Contents:

UNIT I NUMERICAL SOLUTIONS FOR LINEAR AND NON-LINEAR EQUATIONS 9

System of linear equation: Gauss Elimination Method, Gauss Jordan Method, Choleski Method, Gauss-Seidel Method – System of Non-Linear equations : Method of Iteration, Newton-Raphson Method.

UNIT II EIGEN VALUE PROBLEMS AND CURVE FITTING 9

Eigen value problem: Power Method – Curve fitting: Least Square approximations – Fitting a straight line – Regression Lines – Non-Linear curve fitting – Method of least square for continuous functions.

UNIT III NUMERICAL INTEGRATION 9

Trapezoidal Rule - Simpson's Rules-Adaptive Quadrature Method – Gaussian Quadrature-Double integrals using Trapezoidal and Simpson's rule, Electrical Installations Devices

UNIT IV NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 9

Single step methods: Euler's Methods – Modified Euler's Method - Runge-Kutta Method of fourth order – Multi Step methods: Milne's and Adam's Predictor and Corrector Methods. Numerical solution of Ordinary Differential Equation by Finite Difference Method

UNIT V NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9

Laplace Equation: Gauss Jacobi Method, Gauss Seidel Method – Poisson Equation: Finite difference method. Parabolic Equation: Crank Nicholson Method – Hyperbolic Equation: Explicit method

TOTAL: 45 PERIODS

Text Books:

1. P.Kandasamy, K.Thilagavathy, K.Gunavathy, "Numerical Methods", S.Chand and Company Ltd.,Ramnagar, New Delhi, 2010.
2. Veerarajan.T and Ramachandran.T., "Numerical Methods with Programming C", Tata McGraw Hill Publishers, New Delhi, 2007.

Reference Books:

1. Grewal. B. S.,andGrewal. J.S., "Numerical Methods in Engineering and Science", Seventh Edition, Khanna Publishers, New Delhi, 2007.
2. C.F. Gerald and Wheatley. P.O., "Applied Numerical Analysis", (Sixth Edition), Pearson Education,Asia, New Delhi,2006.
3. M.K.Jain, S.R.K. Iyengar and R.K.Jain, "Numerical Methods for Scientific and Engineering Computation", Wiley Eastern Limited, New Delhi, 2004.
4. S.S.Sastry, "Introductory Methods of Numerical Analysis", Prentice Hall of India, New Delhi,2005.
5. Balagurusamy .E., "Numerical Methods", Tata McGraw Hill Publishers, New Delhi,1999, reprint 2007.
6. S.R.K.Iyengar, R.K.Jain, "Numerical Methods", New Age International Publishers, New Delhi, 2009.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3	2	
CO2	3	2	1										3	2	
CO3	2	3	1										3	2	
CO4	2	3	1										3	2	
CO5	2	3	1										3	2	

3	High	2	Medium	1	Low	

Assessment	Marks	Weightage	Marks	IAE Marks	FE	Total Marks
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTE101	ADVANCED HEAT TRANSFER	L	T	P	C
		3	0	0	3
Nature of Course	Professional core				
Pre requisites	Heat and mass transfer				

Course Objectives

The course is intended to

1. Develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows
2. Learn numerical formulation of heat equations and to analyze various heat transfer correlations
3. Understanding of the basic concepts of phase change processes and heat transfer coefficient for compact heat exchangers
4. Identify the application of numerical methods in heat transfer problems.
5. Understand the basic concepts of mass transfer.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Explain the fundamental concept of heat transfer mechanisms.	Understand
CO2	Solve the free and forced convection problems for different geometries with boundary conditions	Apply
CO3	Analyze the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges.	Analyze
CO4	Identify numerical methods for solving the heat transfer problems	Apply
CO5	Evaluate the concepts of phase change in heat and mass transfer processes for various application	Evaluate

Course Contents:

UNIT I CONDUCTION AND RADIATION HEAT TRANSFER 9

One dimensional energy equations and boundary condition - three-dimensional heat conduction equations - extended surface heat transfer - conduction with moving boundaries - radiation in gases and vapour Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media – interaction of radiation with conduction and convection.

UNIT II TURBULENT FORCED CONVECTIVE HEAT TRANSFER 9

Momentum and energy equations - turbulent boundary layer heat transfer - mixing length concept - turbulence model – k Є model - analogy between heat and momentum transfer – Reynolds, Colburn, Prandtl turbulent flow in a tube - high speed flows.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER 9

Condensation with shears edge on bank of tubes - boiling – pool and flow boiling - heat exchanger - Є – NTU approach and design procedure - compact heat exchangers.

UNIT IV NUMERICAL METHODS IN HEAT TRANSFER 9

Finite difference formulation of steady and transient heat conduction problems – discretization schemes – explicit - Crank Nicolson and fully implicit schemes - control volume formulation - steady one-dimensional convection and diffusion problems - calculation of the flow field – SIMPLER algorithm.

UNIT V MASS TRANSFER AND ENGINE HEAT TRANSFER CORRELATION 9

Mass transfer - vaporization of droplets - combined heat and mass transfers - heat transfer correlations in various applications like I.C. engines, compressors and turbines.

TOTAL: 45 PERIODS

Text Books:

1. Yunus A.Cengal., Heat and Mass Transfer – A practical Approach, 3rd edition, Tata McGraw Hill 2007
2. Holman.J.P., Heat Transfer, Tata Mc Graw Hill,2002

References Books

1. Ghoshdastidar. P.S., Heat Transfer, Oxford University Press, 2004.
2. Nag.P.K., Heat Transfer, Tata McGraw-Hill,2002.
3. Ozisik. M.N., Heat Transfer – A Basic Approach, McGraw-Hill Co., 1985.
4. Yadav, R., Heat and Mass Transfer, Central Publishing House, 1995.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3	2	
CO2	3	2	1										3	2	
CO3	2	3	1										3	2	
CO4		3	2	1									3	2	
CO5		3	2	1									3	2	
3	High					2	Medium					1	Low		

Assessment	Marks	Weightage	Marks	IAE Marks	FE	Total Marks
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTE102	ADVANCED THERMODYNAMICS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Engineering **t**thermodynamics				

Course Objectives

The course is intended

1. To impart knowledge of mechanical engineering fundamentals of application.
2. To gain knowledge of thermodynamics process and their applications.
3. To learn the laws thermodynamics of with suitable properties.
4. To develop a clear understanding about thermo chemistry.
5. To explore the knowledge on thermodynamics for refrigeration cycles

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Classify the basic laws of Thermodynamics and study the thermodynamic relations.	Understand
CO2.	Calculate the thermodynamics properties for ideal and real gases	Evaluate
CO3.	Assess the combustion phenomenon using thermo chemistry principles	Evaluate
CO4.	Analysis the thermodynamic system by applying fundamentals of statistical thermodynamics	Apply
CO5.	Choose the power plants and study the thermodynamic phenomenological laws	Analysis

Course contents:

UNIT - I: REVIEW OF THERMODYNAMIC LAWS AND COROLLARIES 9

First and second law thermodynamics, Entropy - Entropy generation. Availability and unavailability, Thermodynamic potential. Maxwell relations, Specific heat relations, Mayer's relation.

UNIT-II: IDEAL AND REAL GASES AND PSYCHOMETRIC 9

Equation of state, Real gas behavior, Vander Waal's equation, Generalization compressibility factor. Energy properties of real gases. Vapour pressure, Clausius, Clapeyro equation. Throttling, Joule. Thompson coefficient. Non reactive mixtures of perfect gases. Governing laws, Evaluation of properties, Psychometric mixture properties and psychometric chart, Air conditioning processes, cooling towers.

UNIT- III: COMBUSTION 9

Combustion Reactions, Enthalpy of formation. Entropy of formation, Reference levels of tables. Energy of formation, Heat of reaction, adiabatic flame temperature, Enthalpies, Equilibrium. Chemical equilibrium of ideal gas, The Vant Hoff's equation. The chemical potential and phase equilibrium.

UNIT- IV KINETIC THEORY OF GASES AND STATISTICAL THERMODYNAMICS 9

Basic assumption, molecular flux, collisions with a moving wall, principle of equipartition of energy, classical theory of specific heat capacity, intermolecular forces, collision cross section, mean free path, energy states and energy levels, macro and micro-scales, thermodynamic probability, thermo statistics, statistical interpretation of entropy, distribution function, application of statistics to gases-mono-atomic ideal gas, distribution of molecular velocities.

UNIT- V: POWER CYCLES AND PHENOMENOLOGICAL LAWS 9

Review binary vapour cycle, co-generation and combined cycles, Second law analysts of cycles. Refrigeration cycles. Thermodynamics of irreversible processes. Introduction Phenomenological laws, Applicability of the Phenomenological relations, Heat flux and entropy production, Thermodynamic phenomena, Thermo electric circuits.

TOTAL: 45 PERIODS

Text Books:

1. Holman J.P., Thermodynamics, Fourth Edition, McGraw – Hill Inc.,1988.
2. Kenneth WarkJt.m., Advanced Thermodynamics for Engineers, McGrew – Hill Inc.,1995.

Reference Books:

1. Wark, Advanced Thermodynamics, McGraw Hill 2000
2. Bejan, A., Advanced Engineering Thermodynamics, John Wiley and Cons,1988.
3. Rao Y.V.C., Postulational and Statistical Thermodynamics, Allied Publisher Limited, New Delhi,1999.
4. Sears F.W. and Salinger G.I., Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Third Edition, Narosa Publishing House, New Delhi,1993.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1										3	2	
CO2		3	2	1									3	2	
CO3		3	2	1									3	2	
CO4	2	3	1										3	2	
CO5	2	3	1										3	2	
	3	High				2	Medium					1	Low		

Assessment	Marks	Weightage	Marks	IAE Marks	FE	Total Marks
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTE103	ADVANCED FLUID MECHANICS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fluid mechanics				

Course Objectives

The course is intended

1. To understand the laws of fluid flow for ideal and viscous fluids
2. To apply the potential functions for standard flows and combined flows
3. To know and examine the viscous flow theory of flow through pipes
4. To recognize the boundary layer concepts with respect to fluid flow
5. To estimate the one dimensional compressible fluid flow

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Recollect the basic equation of fluid flow	Remember
CO2.	Demonstrate the potential functions for standard flows and combined flows	Understanding
CO3.	Examine the Viscous flow theory for various flow fields	Analyze
CO4.	Determine the Boundary Layer - displacement and momentum thickness	Evaluate
CO5.	Estimate the one dimensional compressible fluid flow	Evaluate

Course contents

UNIT I BASIC EQUATIONS OF FLOW 9

Three dimensional continuity equation - differential and integral forms – equations of motion momentum and energy and their engineering applications

UNIT II POTENTIAL FLOW THEORY 9

Rotational and Irrotational flows - Circulation – Vorticity - stream and potential functions for standard flows and combined flows – representation of solid bodies by flow patterns. Pressure distribution over stationery and rotating cylinders in a uniform flow.

UNIT III VISCOUS FLOW THEORY 9

Laminar and turbulent flow - laminar flow between parallel plates - Poiseuille's equation for flow through circular pipes. Turbulent flow - Darcy Weisbach equation for flow through circular pipe - friction factor - smooth and rough pipes - Moody diagram losses during flow through pipes. Pipes in series and parallel – transmission of power through pipes.

UNIT IV BOUNDARY LAYER CONCEPT 9

Boundary Layer - displacement and momentum thickness - laminar and turbulent boundary layers in flat plates - velocity distribution in turbulent flows in smooth and rough boundaries - laminar sub layer.

UNIT V COMPRESSIBLE FLUID FLOW 9

One dimensional compressible fluid flow – flow through variable area passage – nozzles and diffusers – fundamentals of supersonics – normal and oblique shock waves and calculation of flow and fluid properties over solid bodies (like flat plate, wedge, diamond) using gas tables

TOTAL: 45 PERIODS

Text Books:

1. Streeter V.L., Wylie E.B. and Bedford K.W., Fluid Mechanics, WCB McGraw Hill, Boston,1998.
2. Munson B.R., Young D.F. and Okiisi, T.H., Fundamentals of Fluid Mechanics, John Wiley and Sons Inc., NewYork, 1990.

Reference Books:

1. Bansal R.K., Fluid Mechanics, Saurabh and Co., New Delhi, 1985.
2. Kumar K.L., Engineering Fluid Mechanics, Eurasia Publishing House, New Delhi, 2002.
3. Schlichting H., Boundary layer theory, Mc Graw Hill Book Company, 1979
4. Shames, Mechanics of Fluids, Mc Graw Hill Book Company, 1962.8.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1										3	2	
CO2	3	2	1										3	2	
CO3	2	3	1										3	2	
CO4		3	2	1									3	2	
CO5		3	2	1									3	2	
	3	High				2	Medium					1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTE104	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2
Nature of Course	Professional Core				
Pre requisites	Thermal Engineering and Heat transfer				

Course Objectives

The course is intended

1. To make the students to learn the importance of various types of I.C engines and analyze them using commercial and open source software.
2. To study the characteristics of fuels/Lubricates used in IC Engines
3. To study the Performance of Air Compressor
4. To study the heat transfer phenomena predict the relevant coefficient using implementation
5. To find out the performance of cooling tower

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Perform experiments on engines and draw characteristics.	Apply
CO2.	Determine the volumetric efficiency of a two-stage reciprocating air compressor as a function of receiver pressure and air blower.	Apply
CO3.	Contrast Fourier law of conduction for Lagged Pipe and find the overall heat transfer coefficient	Apply
CO4.	Interpret and evaluate the heat transfer coefficient using forced convection and free convection.	Apply
CO5.	Determine the coefficient of performance for heat transfer equipment.	Apply

Course contents

S.No	Exercises	CO Mapping	Blooms Level
IC Engines lab			
1.	Retardation test to find Frictional Power of a Diesel Engine.	CO1	Apply
2.	Performance test on four stroke diesel Engine	CO1	Apply
3.	Performance test on four stroke computerized diesel engine	CO1	Apply
4.	Performance test on Air blower	CO2	Apply
5.	Performance test on a Reciprocating air Compressor	CO2	Apply
Heat Transfer lab			
6.	Determination of overall heat transfer coefficient of Lagged Pipe.	CO3	Apply
7.	Determine the convective heat transfer coefficient in natural convection In Vertical Cylinder	CO4	Apply
8.	Determine the convective heat transfer coefficient in forced	CO4	Apply

	convection		
9.	Determine the effectiveness and efficiency of fins in pin fin apparatus under free and force convection.	CO4	Apply
Applications			
10	Performance study on parallel and counter flow Heat Exchangers.	CO5	Apply
11	Determine the Coefficient of Performance in Air-Conditioning test Rig	CO5	Apply
12	Determine the Experimental Coefficient of Performance in Vapour Compression Refrigeration System	CO5	Apply

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3		3		3	3		3	3	3	2		3	3	
CO2	3		3		3	3		3	3	3	2		3	3	
CO3	3		3		3	3		3	3	3	2		3	3	
CO4	3		3		3	3		3	3	3	2		3	3	
CO5	3		3		3	3		3	3	3	2		3	3	
3 High						2 Medium						1 Low			

TOTAL: 60 PERIODS

SEMESTER-II

22PTE201	INSTRUMENTATION FOR THERMAL ENGINEERING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Thermal Engineering				

Course Objectives

The course is intended to

1. Provide knowledge on various measuring instruments for thermal engineering.
2. Understand the various steps involved in error analysis and uncertainty analysis.
3. Provide knowledge on advance measurement techniques.
4. Gain knowledge of measurement process and their applications.
5. Explore the knowledge on analysis of measurement

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the suitability, accuracy and uncertainty associated with the instrument used for measuring thermal system parameters.	Understand
CO2.	Identify The microprocessors and computers in measurement.	Apply
CO3	Select measuring instruments for advanced applications like process industry.	Apply
CO4	Compare and analysis the performance of advance measurement techniques	Analyze
CO5	Calculate heat release from an IC engine, understand use of flow visualization techniques	Apply

Course Contents:

UNIT I MEASUREMENT CHARACTERISTICS 10

Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments

UNIT II MICROPROCESSORS AND COMPUTERS IN MEASUREMENT 8

Data logging and acquisition – use of sensors for error reduction, elements of microcomputer interfacing, intelligent instruments in use.

UNIT III MEASUREMENT OF PHYSICAL QUANTITIES 9

Measurement of thermo-physical properties, instruments for measuring temperature, pressure and

flow, use of sensors for physical variables.

UNIT IV ADVANCE MEASUREMENT TECHNIQUES 8

Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, heat flux sensors, Telemetry in measurement.

UNIT V MEASUREMENT ANALYSIS 10

Chemical thermal, magnetic and optical gas analyzers, measurement of smoke, Dust and moisture, gas chromatography, spectrometry, measurement of pH, Review of basic measurement techniques.

TOTAL: 45 PERIODS

Text Books:

1 Barnery, Intelligent Instrumentation, Prentice Hall of India, 1988

2. Bolton.W, Industrial Control & Instrumentation, Universities Press, Second Edition, 2001.

Reference Books:

1. Holman J.P., Experimental methods for engineers, McGraw-Hill, 2012.
2. John G Webster, The measurement, Instrumentation and sensors Handbook, CRC and IEE
3. Press, 1999.
4. Morris A.S, Principles of Measurements and Instrumentation Prentice Hall of India, 1998.
5. Nakra, B.C., Choudhry K.K., Instrumentation, Measurements and Analysis Tata McGraw Hill,
6. New Delhi, 2nd Edition 2003.
7. T.G.Beekwith R.D., Marangoni and J.H. Lienhard, Mechanical Measurements, Pearson
8. Education, 2001.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3	2	
CO2	2	3	1										3	2	
CO3	2	3	1										3	2	
CO4	3	2	1										3	2	
CO5		3	2	1									3	2	
	3	High				2	Medium					1	Low		

Assessment	Marks	Weightage	Marks	IAE Marks	FE	Total Marks
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTE202	FUELS AND COMBUSTION	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamental Concepts of Combustion Science and Engineering				

Course Objectives

The course is intended to

1. Describes the environmental problems arising due to the advanced technology.
2. Explains and provides knowledge on the energy resources and their management without wastage and prevention of over-exploitation.
3. Analysis of various types of pollution and its control methods for solving the problems arising due to them.
4. Learn combustion mechanisms of gaseous, liquid and solid fuels.
5. Explain the equipment's involved in combustion

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Summarize the characterization of fuels.	Understand
CO2.	illustrate the various solid and liquid fuels	Understand
CO3.	Discuss about the various gaseous fuels	Understand
CO4.	Analyze the process of combustion processes	Analyze
CO5.	clarify the equipment's involved in combustion	Analyze

Course Contents:

UNIT I FUEL CHARACTERIZATION 8

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels - Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation - Flue gas Analysis - Orsat Apparatus - Fuel & Ash Storage & Handling - Spontaneous Ignition Temperatures.

UNIT II SOLID OF LIQUID FUELS 9

Solid Fuels Types - Coal Family - Properties - Calorific Value - ROM, DMMF, DAF and Bone Dry Basis - Ranking - Bulk & Apparent Density - Storage - Washability - Coking & Caking Coals – Renewable Solid Fuels - Biomass - Wood Waste - Agro Fuels - Manufactured Solid Fuels. Liquid Fuels Types - Sources - Petroleum Fractions - Classification - Refining - Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number.

UNIT III GASEOUS FUELS 8

Gaseous Fuel Classification - Composition & Properties - Estimation of Calorific Value - Gas Calorimeter. Rich & Lean Gas - Wobbe Index - Natural Gas - Dry & Wet Natural Gas - Stripped NG - Foul & Sweet NG - LPG - LNG - CNG - Methane - Producer Gas - Gasifiers - Water Gas - Town Gas - Coal Gasification - Gasification Efficiency - Non - Thermal Route - Biogas – Digesters - Reactions - Viability - Economics.

UNIT IV COMBUSTION: STOICHIOMETRY & KINETICS 12

Stoichiometry – Mass Basis & Volume Basis – Excess Air Calculation – Fuel & Flue Gas Compositions - Calculations – Rapid Methods – Combustion Processes – Stationary Flame – Surface or Flameless Combustion – Submerged Combustion – Pulsating & Slow Combustion Explosive Combustion. Mechanism of Combustion – Ignition & Ignition Energy – Spontaneous Combustion – Flame Propagation – Solid, Liquid & Gaseous Fuels Combustion – Flame Temperature – Theoretical, Adiabatic & Actual – Ignition Limits – Limits of In-flammability.

UNIT V COMBUSTION EQUIPMENTS 8

Coal Burning Equipment's – Types – Pulverized Coal Firing – Fluidized Bed Firing – Fixed Bed & Recycled Bed – Cyclone Firing – Spreader Stokers – Vibrating Grate Stokers – Sprinkler Stokers, Traveling Grate Stokers. Oil Burners – Vaporizing Burners, Atomizing Burners – Design of Burners. Gas Burners – Atmospheric Gas Burners – Air Aspiration Gas Burners – Burners Classification according to Flame Structures – Factors Affecting Burners & Combustion.

TOTAL: 45 PERIODS

Text Books:

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman,1990.
2. B.I. Bhatt and S.M. Vora, Stoichiometry, 2nd Edition, Tata Mcgraw Hill,1984.
3. Blokh A.G., Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn,1988.

Reference Books:

1. Sharma SP., Mohan Chander, Fuels & Combustion, Tata McGraw Hill,1984.
2. Holman J.P., Thermodynamics, Fourth Edition, McGraw-Hill Inc.,1988.
3. Yunus A. Cengel and Michael A. Boles, Thermodynamics, McGraw-Hill Inc.,2006.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3	2	
CO2	3	2	1										3	2	
CO3	3	2	1										3	2	
CO4	1	3	2										3	2	
CO5	1	3	2										3	2	
	3	High				2	Medium					1	Low		

Assessment	Marks	Weightage	Marks	IAE Marks	FE	Total Marks
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
Video presentation	10	5				
Attendance	10	5				

22PTE203	ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Chemistry				

Course Objectives

The course is intended to

1. Impart knowledge on the atmosphere and its present condition, global warming and eco-legislations.
2. Detail on the sources of air, water and noise pollution and possible solutions for mitigating their degradation.
3. Elaborate on the technologies available for generating energy from waste.
4. Learn the Energy Processing and Recovery from Waste
5. Impart knowledge on the pollution from industries

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Explain emission standards	Understand
CO2.	Identify the pollution with suitable waste management system	Analysis
CO3.	Classify the types of power generation	Understand
CO4.	Explain the pollution from various industries.	Understand
CO5.	Select different types of waste water treatment	Apply

Course Contents:

UNIT –I INTRODUCTION 9

Global atmospheric change – greenhouse effect – Ozone depletion - natural cycles - mass and energy transfer – material balance – environmental chemistry and biology – impacts – environmental. Legislations

UNIT – II AIR POLLUTION 9

Pollutants - sources and effect – air pollution meteorology – atmospheric dispersion – indoor air quality - control methods and equipments - issues in air pollution control – air sampling and measurement.

UNIT – III WATER POLLUTION 9

Water resources - water pollutants - characteristics – quality - water treatment systems – waste water treatment - treatment, utilization and disposal of sludge - monitoring compliance with standards.

Unit - IV WASTE MANAGEMENT 9

Sources and Classification – Solid waste – Hazardous waste - Characteristics – Collection and Transportation - Disposal – Processing and Energy Recovery – Waste minimization

Unit – V OTHER TYPES OF POLLUTION FROM INDUSTRIES 9

Noise pollution and its impact - oil pollution - pesticides - instrumentation for pollution control - water pollution from tanneries and other industries and their control – environment impact assessment for various projects – case studies. Radiation pollution: types, sources, effects, control of radiation pollution.

TOTAL: 45 PERIODS

Text Books:

1. Bishop P., Pollution Prevention: Fundamentals and Practice, McGraw-Hill International Edition, McGraw-Hill book Co, Singapore, 2000.
2. G.Masters, Introduction to Environmental Engineering and Science Prentice Hall of India Pvt Ltd, New Delhi, 2003

Reference Books:

1. Arcadio P Sincero and G.A.Sincero, Environmental Engineering–A Design Approach, Prentice Hall of India Pvt Ltd, New Delhi, 2002.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Prentice Hall, 1998.
3. H.Ludwig, W.Evans, Manual of Environmental Technology in Developing Countries, International Book Company, Absecon Highlands N.J.(1991).
4. Rao C.S., Environmental Pollution Control Engineering, 2nd Edition, New Age International Publishers, 2006.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2					1							3	
CO2	3	2					1							3	
CO3	3	2					1							3	
CO4	3					1	2							3	
CO5	3					1	2							3	
	3	High				2	Medium					1	Low		

Assessment	Marks	Weightage	Marks	IAE Marks	FE	Total Marks
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTE204	DESIGN AND OPTIMIZATION OF THERMAL ENERGY SYSTEMS	L	T	P	C
		3	2	0	4
Nature of Course	Professional core				
Pre requisites	Fundamentals of Mechanical Engineering				

Course Objectives

The course is intended to

1. Impart knowledge of mechanical engineering fundamentals of application.
2. Gain knowledge of thermodynamics process and their applications.
3. Learn the laws thermodynamics of with suitable properties.
4. Develop a clear understanding about thermo chemistry.
5. Explore the knowledge on thermodynamics for refrigeration cycles

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Explain the basic design concepts various thermal systems	Remember
CO2.	Apply the design concepts to thermal energy systems	Apply
CO3.	Analyze the different types of optimization technique for problem solving	Analyze
CO4.	Apply the Simulation technique for dynamic behavior.	
CO5.	Study the Case studies on optimization in thermal systems problems	Understand

Course Contents:

UNITI DESIGN CONCEPTS 12

Design Principles, Workable Systems, Optimal Systems, Matching of System Components, Economic Analysis, Depreciation, Gradient Present Worth factor, modeling overview – levels and steps in model development - Examples of models – curve fitting and regression analysis.

UNITII MODELLING AND SYSTEMS SIMULATION 12

Modelling of thermal energy systems – heat exchanger - solar collectors – distillation - rectification turbo machinery components - refrigeration systems - information flow diagram - solution of set of nonlinear lgebraic equations - successive substitution - Newton Raphson method- examples of thermal systems simulation

UNITIII OPTIMIZATION 12

Objectives - constraints, problem formulation - unconstrained problems - necessary and sufficiency conditions. Constrained optimization - Lagrange multipliers, constrained variations, Linear Programming - Simplex tableau, pivoting, sensitivity analysis - New generation optimization techniques – examples

UNITIV DYNAMIC BEHAVIOUR 12

Steady state Simulation, Laplace Transformation, Feedback Control Loops, Stability Analysis, Non-Linearities

UNIT V APPLICATIONS AND CASE STUDIES 12

Case studies of optimization in thermal systems problems- Dealing with uncertainty- probabilistic techniques – Trade-offs between capital and energy using Pinch analysis

TOTAL: 60 PERIODS

Text Books:

1. B.K.Hodge, Analysis and Design of Thermal Systems, Prentice Hall Inc., 1990.
2. Rao S. S., Engineering Optimization Theory and Practice, New Age Publishers,2000.

References Books:

1. D.J. Wide, Globally Optimal Design, Wiley- Interscience,1978.
2. Kapur J. N., Mathematical Modelling, Wiley Eastern Ltd, New York,1989.
3. Stoecker W. F., Design of Thermal Systems, McGraw Hill Edition,1989.
4. YogeshJaluria , Design and Optimization of Thermal Systems , CRC Press ,2007.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3	2	
CO2	2	3	1										3	2	
CO3		3	2	1									3	2	
CO4		3	2	1									3	2	
CO5	3	2	2										3	2	
	3	High				2	Medium					1	Low		

Assessment	Marks	Weightage	Marks	IAE Marks	FE	Total Marks
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTE205	THERMAL SYSTEMS SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

Nature of Course	Professional Core
Pre requisites	Thermodynamics, Thermal Engineering I & II

Course Objectives

The course is intended

1. To learn the modeling and simulation analysis of various thermal engineering application using analysis software's
2. To perform a thermal system simulation and solve for a workable solution using the method of successive substitution
3. To generate an objective function and the appropriate constraints for a complete thermal system design problem

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Make use of heat exchanger analysis using NTU and LMTD method	Apply
CO2.	Experiment with convection heat transfer analysis – Velocity boundary layer and internal flow.	Apply
CO3.	Experiment with radiation heat transfer analysis – emissivity and critical radius of insulation analysis method	Apply
CO4.	Examine the lumped heat transfer analysis method	Apply
CO5.	Simply the condensation heat transfer analysis	Apply

Course Contents:

S.No	Exercises	CO Mapping	Blooms Level
IC engines lab			
1	Heat exchanger analysis – NTU method	1	Apply
2	Heat exchanger analysis – LMTD method	1	Apply
3	Convection heat transfer analysis – Velocity boundary layer.	2	Apply
4	Convection heat transfer analysis – Internal flow	2	Apply
5	Radiation heat transfer analysis – Emissivity	3	Apply
6	Critical radius of insulation	3	Apply
7	Lumped heat transfer analysis	4	Apply
8	Condensation heat transfer analysis	5	Apply

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3		3		2		1		3	3		1	3	3	
CO2	3		3		2		1		3	3		1	3	3	
CO3	3		3		2		1		3	3		1	3	3	
CO4	3		3		2		1		3	3		1	3	3	
CO5	3		3		2		1		3	3		1	3	3	
	3	High				2	Medium					1	Low		

TOTAL: 60 PERIODS

22PTE206	TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1
Nature of Course	Employability Enhancement Course				
Pre requisites	Undergraduate Project Presentation				

Course Objectives:

1. To Enhance the ability of self-study
2. To encourage the students to study advanced engineering developments
3. To Improve presentation and communication skills
4. To prepare and present technical reports.
5. To encourage the students to use various teaching aids such as overhead projectors, PowerPoint presentation and demonstration models.

Course Outcomes:

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Prepare and present technological developments	Understand
CO2	Face the placement interviews	Understand
CO3	Improve the speaking skills	Understand
CO4	Develop your confidence in handling information, making useful notes, and presenting an argument	Understand
CO5	Improve the research and development Knowledge	Understand

GUIDELINES

- The student is expected to present a seminar in one of the current topics in the field of Thermal Engineering related issues / technology.
- The seminar shall be of 30 minutes duration and give presentation to the Seminar Assessment Committee (SAC).
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- In a session of two periods per week, 4 students are expected to present the seminar.
- Students are encouraged to use various teaching aids such as power point presentation and demonstrative models.
- Students are required to prepare a seminar report in the prescribed format given by the department.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-			3	2	3	2	3	2	2	-	-	-
CO2	-	-	-	-	-	1	1	3	3	3	2	2	-	-	-
CO3	-	-	-	-	-	3	1	2	2	2	3	3	-	-	-
CO4	-	-	-	-	-	2	2	3	3	2	3	2	-	-	-
CO5	-	-	-	-	-	3	1	3	2	2	3	3	-	-	-
	3	High					2		Medium			1	Low		

TOTAL: 30 PERIODS

22PTEE01	THERMAL MANAGEMENT SYSTEMS OF EV AND HEV	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	NIL				

Course Objectives

The course is intended to

1. Learn about Current Major Issues and Recent Development Trends in EV
2. Provide knowledge on Fundamentals of hybrid electric vehicles
3. Study about thermal control system configurations for HEV and EV applications
4. Provide knowledge about Rendering of Heat extraction solutions
5. Develop skills in Temperature control and heat transfer using phase change materials

Course Outcomes		
On successful completion of the course, students will be able to		
CO. No	**Course Outcome**	**Bloom's Level**
CO 1	Explain electric vehicle for various applications	Understand
CO 2	Illustrate Hybrid electric vehicle for various applications	Understand
CO 3	Identify the Thermal control in vehicular battery system	Apply
CO 4	Select Modelling and simulation of heat transfer in motors	Apply
CO 5	Construct the thermal system model and parametric study	Apply

Course Contents

Unit – I INTRODUCTION TO EV & HEV **9**

Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, Comparison of EV Vs IC Engine

Unit – II INTRODUCTION TO HEV **9**

Fundamentals of hybrid electric vehicles Series hybrid electric vehicles Parallel hybrid electric vehicles - Start – stop hybrids - Mild hybrids, strong and full hybrids - Extended range hybrid vehicles, and full electric vehicles (BEV)

Unit – III THERMAL MANAGEMENT FOR BATTERIES & POWER ELECTRONICS **9**

Introduction - Thermal control in vehicular battery systems: battery performance degradation at low and high temperatures - Passive, active, liquid, air thermal control system configurations for HEV and EV applications

Unit – IV THERMAL MANAGEMENT OF MOTORS **9**

Motor Sizing vs Heat Generation - Operational Temperature Limitations of Electrical Insulation - Design concepts for Heat Extraction in Motors for EV systems - Modelling and simulation of heat transfer in motors - Rendering of Heat extraction solutions - Sensors and Protection solutions.

Unit – V THERMAL MANAGEMENT SYSTEMS **9**

Overall energy balance to determine required flow rates - Determination of convection and friction coefficients for air and liquid systems in various geometric configurations: flow around cylinders, flow between plates, flow through channels - Development of a complete thermal system model and parametric study results - Temperature control and heat transfer using phase change materials - Thermal Management of Power Electronics.

Total : 45 Periods

Text Books

1. Nag, P.K., “Engineering Thermodynamics”, 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.
2. Sergent,Jerry. andKrum,Al., “Thermal Management Handbook: For Electronic Assemblies Hardcover”, McGraw- Hill. 2005

Reference Books

1. Shabany, Younes.,” Heat Transfer: Thermal Management of Electronics Hardcover”, CRC Press. 2010
2. Obidi,T. Yomi., “Thermal Management in Automotive applications”, SAE International, 2015.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2					1						3	2
CO2	3	2					1						3	2
CO3	2	3					1						3	2
CO4	2	3					1						3	2
CO5	1	3					2						3	2
	3	High				2	Medium					1	Low	

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE02	HYDROGEN AND FUEL CELL TECHNOLOGIES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Fundamental knowledge in Hydrogen and Fuel Cell Technologies				

Course Objectives

The course is intended to

1. To study in detail on the hydrogen production methodologies
2. To learn the possible applications and various storage options.
3. To understand the working principle of a typical fuel cell
4. To gain the knowledge of various types fuel cell and to elaborate on its thermodynamics and kinetics.
5. To study the cost effectiveness and eco-friendliness of Fuel Cells.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Define the properties of hydrogen and its production methodologies	Remember
CO2.	Illustrate the hydrogen storage techniques and its applications	Understand
CO3.	Explain on working principle of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics	Understand
CO4.	Outline the concepts of different fuel cells	Understand
CO5.	Analysis the cost effectiveness and eco-friendliness of Fuel Cells	Analysis

Course Contents:

UNIT –I HYDROGEN – BASICS AND PRODUCTION TECHNIQUES: 9

Hydrogen – physical and chemical properties, salient characteristics. Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water

UNIT – II HYDROGEN STORAGE AND APPLICATIONS: 9

Hypothesis: sources, types and characteristics; Sample survey: sample and census survey, probability, non- probability and mixed sampling

UNIT – III FUEL CELLS: 9

History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery vs fuel cell.

UNIT - IV FUEL CELL – TYPES: 9

Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits

UNIT – V APPLICATION OF FUEL CELL AND ECONOMICS: 9

Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell, Future trends in fuel cells.

Total: 45 Periods

Reference Books:

1. Viswanathan B. and Aulice Scibioh.M, Fuel Cells – Principles and Applications, Universities Press, 2006.
2. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma, 2005.
3. Bent Sorensen (Sørensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, UK2005.
4. Jeremy Rifkin, the Hydrogen Economy, Penguin Group, USA2002. Barclay F.J., Fuel Cells, Engines and Hydrogen, Wiley, 2009.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2				1						3	2	
CO2	3	2	2				1						3	2	
CO3	3	2	2				1						3	2	
CO4	3	2	2				1						3	2	
CO5		3	2				1						3	2	
	3	High		2	Medium							1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE03	ENERGY RESOURCES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Fundamentals of Mechanical Engineering				

Course Objectives

1. To explain concepts of various forms of Non-renewable and renewable energy.
2. To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications.
3. To study the environmental and cost economics of using renewable energy sources compared to fossil fuels.
4. Learn the present energy scenario and the need for energy conservation.
5. Analyze the environmental aspects of renewable energy resources.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Classify the commercial energy and renewable energy sources.	Understand
CO2.	Contrast the working principle of various energy systems.	Understand
CO3.	Identify Winds energy as alternate form of energy and to know how it can be tapped.	Apply
CO4.	Explain bio gas generation and its impact on environment.	Analyze
CO5.	Compare the Geothermal &Tidal energy, its mechanism of production and its applications.	Analyze

Course Contents:

UNIT I COMMERCIAL ENERGY 9

Coal, Oil, Natural gas, Nuclear power and Hydro - their utilization pattern in the past, present and future projections of consumption pattern - Sector-wise energy consumption – environmental impact of fossil fuels – Energy scenario in India – Growth of energy sector and its planning in India.

UNIT II SOLAR ENERGY 9

Solar radiation at the earth's surface – solar radiation measurements – estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors – solar thermal applications - heating, cooling, desalination, drying, cooking, etc – solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells - Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc - solar PV power plant – Net metering concept.

UNIT III WIND ENERGY 9

Nature of the wind – power in the wind – factors influencing wind – wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications – offshore wind energy - Hybrid systems - safety and environmental aspects – wind energy potential and installation in India – Repowering concept.

UNIT IV BIO-ENERGY 9

Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - direct combustion – biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - types of biogas Plant - applications - alcohol production from biomass – bio diesel production – Urban waste to energy conversion - Biomass energy programme in India.

UNIT V OTHER TYPES OF ENERGY 9

Ocean energy resources - principle of ocean thermal energy conversion (OTEC) - ocean thermal power plant - ocean wave energy conversion - tidal energy conversion – small hydro - geothermalenergy-geothermalpowerplant–hydrogenproductionandstorage-Fuelcell– principle of working - various types - construction and applications.

Total = 45 Periods

Reference Books:

1. Kishore V.V.N., “Renewable Energy Engineering and Technology”, Teri Press, New Delhi, 2012
2. Peter Gevorkian, “Sustainable Energy Systems Engineering,” McGraw-Hill, 2007.
3. Godfrey Boyle, “Renewable Energy Power for a Sustainable Future”, Oxford University Press, U.K, 1996.
4. Bent Sorensen, “Renewable Energy”, Elsevier, Academic Press, 2011.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3			2				3			3		3	3	1
CO2	3			2				3			3		3	3	1
CO3	3			2				3			3		3	3	1
CO4	3			2				3			3		3	3	1
CO5	3			2				3			3		3	3	1
	3	High				2	Medium					1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE04	ADVANCED INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Thermal Engineering				

Course Objectives

The course is intended to

1. To update the knowledge in engine exhaust emission control.
2. To make aware of alternate fuels and its significance.
3. To enable the students to understand the recent developments in IC Engines.
4. To educate them with the technological advancements of I.C Engine.
5. To educate students with the technological advancements of S.I Engine.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	List the various types of I.C. Engines and its Cycles of operation.	Remember
CO2.	Explain the performance parameters in IC Engines.	Understand
CO3.	Summarize the causes of emission.	Understand
CO4.	Estimate the engines performance with alternative fuels.	Evaluate
CO5.	Validate the environmental and social impact of IC Engines.	Evaluate

Course Contents:

UNIT I SPARK IGNITION ENGINES 9

Spark ignition Engine mixture requirements – Fuel – Injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – factors affecting knock – Combustion chambers.

UNIT II COMPRESSION IGNITION ENGINES 9

States of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers – Fuel spray behavior – spray structure, spray penetration and evaporation – air motion – Introduction to Turbo charging.

UNIT III POLLUTANT FORMATION AND CONTROL 9

Pollutant – Sources – Formation of carbon monoxide, Unburnt hydrocarbon, NOx, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters and Particulate Traps – Methods of measurements and Introduction to emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUELS 9

Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas- Properties, Suitability, Merits and Demerits as fuels, Engine Modifications.

UNIT V RECENT TRENDS 9

Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition engines – Plasma Ignition – Measurement techniques – laser Doppler, Anemometry. Use of nano technology in IC Engines.

Total = 45 Periods

Text Books:

1. K.K. Ramalingam, Internal Combustion Engine fundamentals, SciTech Publications, 2002.
2. Ganesan V., Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007

Reference Books:

1. K.K. Ramalingam, Internal Combustion Engine fundamentals, SciTech Publications, 2002.
2. Kirpal Singh, Automobile Engineering Vol - I, Standard Publishers, Delhi 2013.
3. V. Ganesan, Internal Combustion Engines, II Edition, Tata McGraw-Hill Education, 2002.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2					1						3	2	
CO2	3	2					1						3	2	
CO3	3	2					1						3	2	
CO4		3	2				1						3	2	
CO5		3	2				1						3	2	
	3	High				2	Medium					1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE05	ADVANCES IN METROLOGY AND INSPECTION	L	T	P	C
		3	0	0	3
Nature of Course	Professional elective				
Pre requisites	Inspection, Analysis of Thermal Components				

Course Objectives

1. To basic concepts in various methods of engineering measurement techniques and applications.
2. To understand the importance of measurement and inspection in manufacturing industries.
3. To make the students capable of learning to operate and use advanced metrological devices with ease in industrial environments.
4. To design and develop a new measuring methods.
5. Understand the advanced measurement techniques used in industries.

Course Outcomes

On successful completion of the course, students will be able to

CO No	Course Outcomes	Blooms Level
CO 1	Understand the advanced measurement principles	Understand
CO 2	Select the sophisticated measurement and inspection facilities	Remember
CO 3	Choose the new measuring methods for Inspection	Evaluate
CO 4	List the Measuring instruments and its applications	Analyze
CO 5	Applying the Image Processing technique in Metrology	Apply

Course Contents:

UNIT I CONCEPTS OF METROLOGY **8**

Terminologies – Standards of measurement – Errors in measurement – Interchangeability and Selective assembly – Accuracy and Precision – Calibration of instruments – Basics of Dimensional metrology and Form metrology

UNIT II MEASUREMENT OF SURFACE ROUGHNESS **9**

Definitions – Types of Surface Texture: Surface Roughness Measurement Methods-Comparison, Contact and Non-Contact type roughness measuring devices, 3D Surface Roughness Measurement, Nano Level Surface Roughness Measurement – Instruments.

UNIT III INTERFEROMETRY **8**

Introduction, Principles of light interference – Interferometers – Measurement and Calibration – Laser Interferometry.

UNIT IV MEASURING MACHINES AND LASER METROLOGY **10**

Tool Makers Microscope – Microhite – Coordinate Measuring Machines – Applications – Laser Micrometer, Laser Scanning gauge, Computer Aided Inspection techniques - In-process inspection, Machine Vision system-Applications.

UNIT V IMAGE PROCESSING FOR METROLOGY **10**

Overview, Computer imaging systems, Image Analysis, Preprocessing, Human vision system, Image model, Image enhancement, gray scale models, histogram models, Image Transforms - Examples.

Total: 45 Periods

References:

1. Bewoor, A.K. and Kulkarni, V.A., ”Metrology and Measurement”, Tata Mc Graw-Hill, 2009.
2. Jain, R.K., “Engineering Metrology”, Khqanna Publishers, 2008.
3. Rajput,R.K., “Engineering Metrology and Instrumentations”, Kataria & Sons Publishers,2001.
4. Smith,G.T., “Industrial Metrology”, Springer,2002
5. Sonka,M., Hlavac,V. and Boyle.R., “Image Processing, Analysis, and Machine Vision”, Cengage- Engineering,2007.
6. Whitehouse, D.J., "Surface and their measurement", Hermes Penton Ltd, 2004.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2			1								3	1	
CO2	3	2			1								3	1	
CO3	3	3	2			1							3	1	
CO4		3	2			1							3	1	
CO5	2	3				1							3	1	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE06	SYNTHESIS AND CHARACTERIZATION OF NANO MATERIALS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Fundamentals of Mechanical Engineering				

Course Objectives

The course is intended to

1. To gain deeper knowledge and understanding about the synthesis of materials
2. Understand various advanced characterization equipment used to characterize different types of materials.
3. Get knowledge of phase transformation and crystallization of materials, and skill for nucleation and growth pattern of a nanoparticle
4. Understand mono dispersed nanoparticle synthesis.
5. To learn Mechanical Behavior of Nano Particulars

Course Outcomes

On successful completion of the course the students will be able to

CO. No	Course Outcome	Bloom's Level
Co 1	Define basic principles of the synthesis and characterization techniques	Remembering
CO 2	Illustrate Deposition Techniques of Nano particulars	Understand
CO 3	Classify the Application of Microscopy	Analyze
CO4	Explain the Mechanical Behavior of Nano Particulars.	Understand
CO 5	Demonstrate the Thermal Properties of Nano Materials	Remembering

Course Contents

UNIT I INTRODUCTION TO NANO MATERIALS 9

Synthesis of nanomaterials: Gold, Silver, different types of Nano oxides, TiO2, ZnO by using sol-gel method, Co-precipitation, Hydrothermal, Microwave, , Nanotubes and Nanowires, Carbon nanotubes, Graphene preparation, powder syntheses, crystal growth techniques, zone refining, properties and applications.

UNIT II DEPOSITION TECHNIQUES 9

Deposition techniques: Chemical vapour deposition (CVD), Metal Organic chemical vapour deposition (MOCVD), Epitaxial growth techniques: Molecular beam epitaxial, Atomic layer deposition, Pulsed laser deposition, Pulsed electrochemical deposition

UNIT III CHARACTERIZATION OF NANOMATERIALS 9

Principle, Theory, Working and Application; X-Ray Diffraction, Field Emission Scanning Electron Microscopy, High Resolution-Transmission Electron Microscopy, Atomic Force Microscopy

UNIT IV SYNTHESIS OF NANOMATERIALS 9

Top down and bottom up synthesis- mechanical alloying, Mechanical ball-milling, Ion implantation, Inert gas condensation, Arc discharge, RF-plasma arc technique, Laser ablation, Template assisted synthesis, Clusters, Colloids, Zeolites, Porous silicon.

UNIT V THERMAL ANALYTICAL TECHNIQUE 9

Thermal analysis – Differential Scanning Calorimetry (DSC) – Thermo gravimetric Analysis (TGA) – Differential Thermal Analysis (DTA) – Dynamic Mechanical Analysis (DMA), Mechanical Testing- Nano Indentation -Vibrating Sample Magnetometer, Zeta Potential and Particle size measurement.

Total : 45 Periods

Text Books

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate (Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 2002.
2. K. Barriham, D.D. Vvedensky, Low dimensional semiconductor structures: fundamental and device applications, Cambridge University Press, 2001.

Reference Books

1. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties &Applications, Imperial College Press, 2004.
2. J. George, Preparation of Thin Films, Marcel Dekker, Inc., New York.2005.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2					1						3	2	
CO2	3	2					1						3	2	
CO3	2	3					1						3	2	
CO4	3	2					1						3	2	
CO5	3	2					1						3	2	
	3	High				2	Medium					1	Low		

Assessment	Marks	Weightage	Marks	IAE Marks	FE	Total Marks
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE07	POLYMERS AND COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3
Nature of Course	Professional elective				
Pre requisites	Composites, polymers and its Characterization				

Course Objectives

1. To teach the students basic concepts in various methods of engineering Materials and applications.
2. Understand the importance of Composite Materials in manufacturing industries.
3. To impart knowledge on types, physical properties and processing of polymer matrix composites
4. To design and develop new Processing methods involved in Ceramics composites.
5. Understand the advanced Process involved in metal matrix composites used in industries.

Course Outcomes

On successful completion of the course the students will be able to

CO No	Course Outcomes	Blooms Level
CO 1	Explain the composite material, reinforcements of polymer composites.	Understand
CO 2	Develop knowledge on processing, interfacial properties and application of composites.	Apply
CO 3	Select reinforcements of polymer matrix composites	Apply
CO 4	List the Process of Metal matrix Composites	Understand
CO 5	Importance of Processing technique in Ceramic Matrix Composites and its applications.	Apply

Course Contents:

UNIT I PROCESSINGOF POLYMERS 9

Chemistry and Classification of Polymers – Properties of Thermo plastics – Properties of Thermosetting Plastics - Extrusion – Injection Moulding – Blow Moulding – Compression and Transfer Moulding – Casting – Thermo Forming. General Machining properties of Plastics – Machining Parameters and their effect – Joining of Plastics – Thermal bonding – Applications.

UNIT II FIBERS AND MATRIX MATERIALS 9

Fibers – Fabrication, Structure, properties and applications – Glass fiber, Boron fiber, carbon fiber, organic fiber, ceramic and metallic fibers - whiskers–Fabrication of Matrix materials – polymers, metals and ceramics and their properties – interfaces – Wettability – Types of bonding at the interface – Tests for measuring interfacial strength - Physical and chemical properties.

UNIT III PROCESSING OF POLYMERMATRIX COMPOSITES 9

Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding with Bulk Moulding Compound and sheet Moulding Compound – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding – interfaces in PMCs - structure, properties and application of PMCs –recycling of PMCs.

UNIT IV PROCESSING OF METAL MATRIX COMPOSITES 9

Metallic matrices: aluminium, titanium, magnesium, copper alloys – processing of MMCs: liquid state, Solid state, in situ fabrication techniques – diffusion bonding – powder metallurgy techniques- interfaces in MMCs – mechanical properties – machining of MMCs – Applications.

UNIT V PROCESSING OF CERAMIC MATRIX AND CARBON-CARBON COMPOSITES 9

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, sol-gel interfaces in CMCs – mechanical properties and applications of CMCs – Carbon-carbon Composites – applications.

Total: 45 Periods

Reference Books:

1. Harold Belofsky, Plastics, Product Design and Process Engineering, Hanser Publishers, 2002.
2. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012.
3. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010.
4. Mallick, P.K. and Newman.S., Composite Materials Technology, Hanser Publishers,2003.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3						2	2	2			3	1	
CO2	3	3						2	2	2			3	1	
CO3	3	3						2	2	2			3	1	
CO4	3	3						2	2	2			3	1	
CO5	3	3						2	2	2			3	1	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

ELECTIVE III & IV

22PTEE11	COMPUTATIONAL FLUID DYNAMICS FOR THERMAL SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Computational Fluid Dynamics for Thermal Systems				

Course Objectives

The course is intended to

1. This course aims to introduce numerical modeling and its role in the field of heat, fluid flow and combustion.
2. It will enable the students to understand the various discretization methods and solving methodologies
3. To create confidence to solve complex problems in the field of heat transfer and fluid dynamics.
4. To develop finite volume discretized forms of the CFD equations.
5. To formulate explicit & implicit algorithms for solving the Euler Equations & Navier Stokes Equations.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Summarize the governing differential equation in heat transfer	Understand
CO2.	Solve the steady diffusion problems for different dimensions	Apply
CO3.	Examine the finite volume method	Analyze
CO4.	List the various type of flow process	Analyze
CO5.	Discuss the description of turbulent flow and its modelling	Understand

Course Contents:

UNIT I GOVERNING DIFFERENTIAL EQUATIONS AND DISCRETIZATION TECHNIQUES **9**

Basics of Heat Transfer, Fluid flow – Mathematical description of fluid flow and heat transfer – Conservation of mass, momentum, energy and chemical species - Classification of partial differential equations – Initial and Boundary Conditions – Discretization techniques using finite difference methods – Taylor's Series - Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II DIFFUSION PROCESSES: FINITE VOLUME METHOD **9**

Steady one-dimensional diffusion, Two and three dimensional steady state diffusion problems, Discretization of unsteady diffusion problems – Explicit, Implicit and Crank-Nicholson's schemes, Stability of schemes

UNIT III CONVECTION – DIFFUSION PROCESSES: FINITE VOLUME METHOD **9**

One dimensional convection – diffusion problem, Central difference scheme, upwind scheme – Hybrid and power law discretization techniques – QUICK scheme

UNIT IV FLOW PROCESSES: FINITE VOLUME METHOD **9**

Discretization of incompressible flow equations – Pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms

UNIT V TURBULENCE AND ITS MODELING **9**

Description of turbulent flow, free turbulent flows, flat plate boundary layer and pipe flow, Algebraic Models, One equation model, k – ε & k – ω models Standard and High and Low Reynolds number models

Total: 45 Periods

References

1. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and HeatTransfer " Hemisphere Publishing Corporation, New York, USA,2012.
2. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2003.
3. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2003.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1										3	2	
CO2	2	3	1										3	2	
CO3	2	3	1										3	2	
CO4	2	3	1										3	2	
CO5	3	2	1										3	2	
	3	High				2	Medium					1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE12	FANS, BLOWERS AND COMPRESSORS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Fundamental knowledge in Prime movers				

Course Objectives

The course is intended to

1. To develop knowledge about turbo machinery and its working principles.
2. To formulate analysis of compressors, centrifugal blowers and testing of fans.
3. To understand the design concepts of compressors
4. To analysis various testing and control techniques of fans
5. To understand the blowers control techniques in thermal applications

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Understand about Turbo machinery and its working principles	Remember
CO2.	Analysis function and characteristics of blowers and fans	Apply
CO3.	Understand the design concepts of compressors	Understand
CO4.	Analysis various testing and control techniques of fans	Apply
CO5.	Apply a blowers control techniques in thermal applications	Apply

Course Contents:

UNIT – I PRINCIPLES OF TURBO MACHINERY 9

Introduction to turbo machines - Transfer of energy to fluids - Performance characteristics - fan laws - Dimensionless parameters - Specific speed - selection of centrifugal, axial, and mixed flow machines

UNIT – II ANALYSIS OF CENTRIFUGAL BLOWERS AND FANS: 9

Centrifugal Blowers: Theoretical characteristic curves, Euler's characteristics and Euler's velocity triangles, losses and hydraulic efficiency, flow through impeller inlet volute, diffusers, leakage disc friction mechanical losses multivane impellers of impulse type, cross flow fans.

UNIT – III ANALYSIS OF COMPRESSOR: 9

Rotor design airfoil theory, vortex theory, cascade effects, degree of reaction, blade twist stage design, surge and stall, stator and casing, mixed flow impellers.

UNIT - IV TESTING AND CONTROL OF FANS 9

Fan testing, noise control, materials and components blower regulation, speed control, throttling, control at discharge and inlet

UNIT – V APPLICATIONS OF BLOWERS 9

Applications of blowers induced and forced draft fans for air conditioning plants, cooling towers, ventilation systems, booster systems.

Total: 45 Periods

Passed in Board of Studies Meeting on 25.02.2022 Passed in Academic Council Meeting on 09.03.2022

Reference

1. S.M. Yahya, Turbines, Compressors and Fans, Tata McGraw-Hill Education, 2000.
2. Austin H. Church, Centrifugal pumps and blowers, John Wiley and Sons, 1990.
3. Dixon, Fluid Mechanics, Thermodynamics of turbomachinery, Pergamon Press, 1984.
4. Dixon, Worked examples in turbomachinery, Pergamon Press, 1984.
5. Earl Logan Jr., Ramendra Roy, Handbook of Turbomachinery, Second Edition, Marcel Dekker, Inc, New York, 2003.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1										3	2	
CO2	2	3	1										3	2	
CO3	3	2	1										3	2	
CO4	2	3	1										3	2	
CO5	2	3	1										3	2	
	3	High				2	Medium					1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE13	FOOD PROCESSING, PRESERVATION AND TRANSPORT	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	None				

Course Objectives

The course is intended to

1. To develop knowledge about food products, Mechanism of food spoilage critical microbial growth requirements and design for control of microorganisms
2. To understand methods of food processing and preservation of foods
3. To understand the various methods of food freezing and drying.
4. To understand the concepts of cold storage design & instrumentation systems
5. To understand packing and transporting food products.

Course Outcomes

On successful completion of this course the student will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Apply the knowledge about food products, Mechanism of food spoilage critical microbial growth requirements and design for control of microorganisms	Apply
CO2.	Summaries methods of food processing and preservation of foods	Understand
CO3.	Analysis the various methods of food freezing and drying techniques	Analyze
CO4.	Classify the concepts of cold storage design & instrumentation systems	Understand
CO5.	List the packing and transporting food products.	Understand

Course contents:

UNIT I INTRODUCTION 9

Microbiology of Food Products, Mechanism of food spoilage critical microbial growth requirements, Design for control of microorganisms, The role of HACCP, Sanitation, Regulation and standards.

UNIT II PROCESSING & PRESERVATION 12

Thermodynamic properties and Transfer properties, Water content, Initial freezing temperature, Ice fraction, Transpiration of fresh fruits & vegetables, Food processing techniques for Dairy products, Poultry, Meat, Fruits & Vegetables.

UNIT III FREEZING & DRYING 12

Precooling, Freeze drying principles, Cold storage & freezers, Freezing drying limitations, Irradiation techniques, Cry freezing, Numerical and analytical methods in estimating Freezing, Thawing times, Energy conservation in food industry.

UNIT IV COLD STORAGE DESIGN & INSTRUMENTATION 7

Initial building consideration, Building design, Specialized storage facility, Construction methods, Refrigeration systems, Insulation techniques, Control & instrumentation, Fire protection, Inspection &maintenance

UNIT V PACKAGING AND TRANSPORT **5**

Refrigerated transportation, Refrigerated containers & trucks, Design features, Piping & Role of cryogenics in freezing & transport. Basic packaging materials, types of packaging, Packaging design. Packaging for different types of foods.

TOTAL : 45 PERIODS

References

1. Ibraham Dincer, Heat Transfer in Food Cooling Applications, Tailor & Francis Pub.,2001.
2. Stanley E. Charm, Fundamentals of Food Engineering, III Edition, AVI Pub. Company Inc. 1989.
3. Clive V.I. Dellino, Cold and Chilled Storage Technology, Van Nostrand Reinhold Pub. New York,1991.
4. Arora C.P., Refrigeration and Air conditioning II Edition, McGraw-Hill, Pub.,2000.
5. Fellows P.J., Food processing Technology: Principle and Practices, Wood Head Publishing, 1997.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	3	1										3	1	
CO2	2	3	1										3	1	
CO3	2	3	1										3	1	
CO4	3	2	1										3	1	
CO5	3	2	1										3	1	
	3	High				2	Medium					1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE14	COMPUTATIONAL HEAT TRANSFER	L	T	P	C
		3	0	0	3

Nature of Course	Professional Elective
Pre requisites	Thermodynamics, fluid mechanics and heat transfer, along with a basic understanding of engineering materials.

Course objectives:

The course is intended to

1. Make the students learn to solve conductive, transient conductive, convective problems
2. Students learn to solve radiative heat transfer problems using computational methods.
3. Know that heat conduction problem with different boundary conditions
4. Perform treatment(FDM) of steady and unsteady 1-D and 2-d heat convection
5. Developing a numerical code for 1D, 2D heat transfer problems.

Course outcomes:

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Explain the Forward, backward and central differencing scheme	Understand
CO2	Develop the heat conduction equation in Cartesian, cylindrical and spherical coordinates	Apply
CO3	Analysis the I-D,2-D transient heat Conduction problems	Analyze
CO4	Analysis the Computation of thermal and Velocity boundary layer flows	Analyze
CO5	Solve the Numerical treatment of radiation enclosures using finite Volume method	Apply

Course contents:

UNIT I INTRODUCTION **9**

Finite Difference Method-Introduction-Taylor"s series expansion - Discretisation Methods Forward, backward and central differencing scheme for Ist order and second order Derivatives — Types of partial differential equations-Types of errors. Solution to algebraic equation-Direct Method and Indirect Method-Types of boundary condition. FDM - FEM - FVM.

UNIT II CONDUCTIVE HEAT TRANSFER **9**

General 3D-heat conduction equation in Cartesian, cylindrical and spherical coordinates. Computation (FDM) of One — dimensional steady state heat conduction –with Heat generation- without Heat generation- 2D-heat conduction problem with different boundary conditions- Numerical treatment for extended surfaces. Numerical treatment for 3D- Heat conduction. Numerical treatment to 1D-steady heat conduction using FEM.

UNIT III TRANSIENT HEAT CONDUCTION **9**

Introduction to Implicit, explicit Schemes and crank-Nicolson Schemes Computation (FDM) of One –Dimensional un-steady heat conduction –with heat Generation-without Heat generation - 2D- transient heat conduction problem with different boundary conditions using Implicit, explicit Schemes. Importance of Courant number. Analysis for I-D,2-D transient heat Conduction problems.

UNIT IV CONVECTIVE HEAT TRANSFER **9**

Convection- Numerical treatment (FDM) of steady and unsteady 1-D and 2-d heat convection- diffusion steady-unsteady problems- Computation of thermal and Velocity boundary layer flows. Upwind scheme. Stream function-vorticity approach-Creeping flow

UNIT V Radioactive Heat Transfer **9**

Radiation fundamentals-Shape factor calculation-Radiosity method- Absorption Method- Montacalro method-Introduction to Finite Volume Method- Numerical treatment of radiation enclosures using finite Volume method. Developing a numerical code for 1D, 2D heat transfer problems.

Total: 45 Periods

References

1. T.J. Chung, Computational Fluid Dynamics, Cambridge University Press, 2002

2. Yunus A. Cengel, Heat Transfer – A Practical Approach Tata McGraw Hill Edition, 2003.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	3	1										3	1	
CO2	2	3	1										3	1	
CO3	2	3	1										3	1	
CO4	3	2	1										3	1	
CO5	3	2	1										3	1	
	3	High		2	Medium							1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE15	AIR CONDITIONING SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	None				

Course Objectives

1. To learn the psychometric concepts underlying Air conditioning process.
2. To learn the design features and load estimation principles of specific Air conditioning system.
3. To learn about the critical auxiliary systems such as air distribution circuits, water distribution circuits etc.
4. To evaluate the cooling load for air conditioning systems used for various Characteristics
5. To understand the conceptually the design of a HVAC system in automobiles.

Course Outcomes

On successful completion of this course the student will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Illustrate the cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems	Understand
CO2.	List the properties, applications and environmental issues of different refrigerants	Analyze
CO3.	Classify the fundamental principles and different methods of air conditioning	Analyze
CO4.	Evaluate the cooling load for air conditioning systems used for various Characteristics	Evaluate
CO5.	Analyze the air conditioning systems in automobiles	Analyze

Course contents:

UNIT I PSYCHROMETRY AND AIR CONDITIONING PROCESSES 9

Moist Air properties, use of Psychrometric Chart, Various Psychrometric processes, Air Washer, Adiabatic Saturation. Summer and winter Air conditioning, Enthalpy potential and its insights.

UNIT II LOAD ESTIMATION 10

Thermal comfort – Design conditions – Solar Radiation-Heat Gain through envelopes – Infiltration and ventilation loads – Internal loads – Procedure for heating and cooling load estimation.

UNIT III AIR CONDITIONING SYSTEMS 8

Thermal distribution systems – Single, multi zone systems, terminal reheat systems, Dual duct systems, variable air volume systems, water systems and Unitary type systems.

UNIT IV AIR DISTRIBUTION AND CONTROL 10

Flow through Ducts, Static & Dynamic Losses, Diffusers, Duct Design–Equal Friction Method, System Balancing, Fans & Duct System Characteristics, Fan Arrangement Variable Air Volume systems, Air Handling Units and Fan Coil units – Control of temperature, humidity, air flow and quality.

UNIT V HVAC SYSTEM IN AUTOMOBILES 8

Automotive System layout and Components- Commonly used Refrigerants- Safety devices – Climate control – Fuel efficiency aspects.

TOTAL = 45 PERIODS

References

1. Ali Vedavarz, Sunil Kumar, Mohammed Iqbal, Hussain Handbook of Heating, Ventilation and Air conditioning for Design Implementation, Industrial press Inc, 2007.
2. Arora C.P., Refrigeration and Air Conditioning, Tata McGraw Hill Pub. Company, 2010.
3. Ashrae, Fundamentals and equipment, 4 volumes-ASHRAE Inc.2005.
4. Jones, Air Conditioning Engineering, Edward Amold pub.2001.
5. Kuehn T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall,1998
6. Langley, Billy C., Refrigeration and Air Conditioning Ed. 3, Engie wood Cliffs (N.J) Prentice Hall1986.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2					1						3	1	
CO2	2	3					1						3	1	
CO3	2	3					1						3	1	
CO4	2	3					1						3	1	
CO5	2	3											3	1	
	3	High				2	Medium					1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
video presentation/Assignment	10	5				
Attendance	10	5				

22PTEE16	MATERIALS TESTING AND CHARACTERIZATION TECHNIQUES	L	T	P	C
		3	0	0	4
Nature of Course	Professional elective				
Pre requisites	Material testing				

Course Objectives

1. This course aims to impart knowledge on various techniques of material characterization.
2. Understand the importance of microstructure evaluation, crystal structure analysis.
3. To impart knowledge on Chemical and Thermal Analysis.
4. To Design and develop a new methods involved in Mechanical testing.
5. Understand the advanced Process involved in Dynamic tests in industries.

Course Outcomes

On successful completion of this course the student will be able to

CO No	Course Outcomes	Blooms Level
CO 1	Define the Micro and Crystal structure analysis	Understand
CO 2	Develop the knowledge on Electron Microscopy techniques.	Remember
CO 3	Select reinforcements of polymer matrix composites and its applications.	Evaluate
CO 4	List the Process of Mechanical testing-Staic Tests	Analyze
CO 5	Importance of Mechanical testing-Dynamic Tests	Apply

Course contents:

UNIT I MICRO AND CRYSTALSTRUCTUREANALYSIS 10

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallography – Estimation of grain size – ASTM grain size numbers–Microstructure of Engineering Materials Elements of Crystallography – X-ray Diffraction – Bragg's law – Techniques of X-ray Crystallography – Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns – Inter planer spacing – Identification of Crystal Structure, Elements of Electron Diffraction.

UNIT II ELECTRON MICROSCOPY 9

Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF & DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction & working of SEM – various Imaging Techniques – Applications- Atomic Force Microscopy- Construction & working of AFM - Applications .

UNIT III CHEMICAL AND THERMAL ANALYSIS 9

Basic Principles, Practice and Applications of X-Ray Spectrometry, Wave Dispersive X-Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravity metric Analysis (TGA)

UNITIV MECHANICAL TESTING –STATICTESTS **8**

Hardness– Brinell, Vickers, Rockwell and Micro Hardness Test–Tensile Test–Stress–Strain plot – Proof Stress – Torsion Test - Ductility Measurement – Impact Test – Charpy & Izod – DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

UNITV MECHANICAL TESTING –DYNAMIC TESTS **9**

Fatigue – Low & High Cycle Fatigues – Rotating Beam & Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – AE Tests-modal analysis - Applications of Dynamic Tests.

Total: 45 Periods

References:

1. ASM Hand book-Materials characterization, Vol – 10,2004.
2. Culity B.D., Stock S.R& Stock S., Elements of X ray Diffraction, (3rd Edition). Prentice Hall, 2001.
3. Davis J. R., Tensile Testing, 2nd Edition, ASM International, 2004.
4. Goldsten,I.J., Dale.E., Echin.N.P.& Joy D.C., Scanning Electron Microscopy & X ray- Micro Analysis, (2nd Edition), ISBN – 0306441756, Plenum Publishing Corp.,2000.
5. Morita.S, Wiesendanger.R, and Meyer.E, “Non-contact Atomic Force Microscopy” Springer, 2002,

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3						2	2	2			3	1	
CO2	3	3						2	2	2			3	1	
CO3	3	3						2	2	2			3	1	
CO4	3	3						2	2	2			3	1	
CO5	3	3						2	2	2			3	1	
	3	**High**				**2**	**Medium**					**1**	**Low**		

Assessment	Marks	Weightage	Marks	IAE Marks	FE	Total Marks
IAE – I	50	7.5	25	40	60	100
IAE – II	50	7.5				
IAE – III	50	10				
Quiz/Presentation/Tutorial	10	5	15			
presentation/Assignment	10	5				
Attendance	10	5				

22PTEE17	ALTERNATIVE FUELS FOR IC ENGINES	L	T	P	C
		3	0	0	3
Nature of Course	Professional elective				
Pre requisites	Fundamental of IC Engines				

Course Objectives

1. To understanding of the engineering issues and perspectives affecting fuel and engine development
2. To examine future trends and development, including hydrogen as an internal combustion engine fuel.
3. To explore further fuel specification and performance requirements for advanced combustion Systems.
4. To understand the various alternative fuel options available for conventional fuels and their performance and emission characteristics.
5. To classify the combustion in spark compression ignition by gaseous fuels

Course Outcomes

On successful completion of this course the student will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Solve a problem oriented in depth knowledge of Alternate fuel and energy system	Apply
CO2.	Identify the combustion in spark ignition by liquid fuels	Understand
CO3.	Inspect the combustion in spark compression ignition by liquid fuels	Analyze
CO4.	Measure the combustion in spark ignition by gaseous fuels	Evaluate
CO5.	Classify the combustion in spark compression ignition by gaseous fuels	Understand

Course contents:

UNIT I INTRODUCTION 12

Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels – Ethanol, Methanol, Diethyl ether, Dimethyl ether, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Bio- gas and Bio-diesel.

UNIT II LIQUID FUELS FOR S.I.ENGINES 9

Requirements, Utilisation techniques – Blends, Neat form, Reformed Fuels, Storage and Safety, Performance and Emission Characteristics

UNIT III LIQUID FUELS FOR C.I.ENGINES 8

Requirements, Utilisation techniques - Blends, Neat fuels, Reformed fuels, Emulsions, Dual fuelling, Ignition accelerators and Additives, Performance and emission characteristics.

UNITI V GASEOUS FUELS FOR S.I.ENGINES 8

Hydrogen, Compressed Natural gas, Liquefied Petroleum gas, and Bio gas in SI engines – Safety Precautions – Engine performance and emissions.

UNIT V GASEOUS FUELS FOR C.I.ENGINES 8

Hydrogen, Biogas, Liquefied Petroleum gas, Compressed Natural gas in CI engines. Dual fuelling, Performance and emission characteristics.

Total = 45 Periods

References

1. Osamu Hirao and RichardK. Pefley, Present and Future Automotive Fuels, John Wiley and Sons, 2000.
2. Roger F. Haycock and John E Hillier., Automotive Lubricants Reference Book, Second Edition, SAE International Publications, 2004.
3. RichardL. Bechfold – Alternative Fuels Guide Book-SAE International Warrendale, 1997.
4. Sharma SP, Mohan Chander, Fuels & Combustion, Tata McGraw Hill, 1984.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3					2	1						3	1	
CO2	3					2	1						3	1	
CO3	3					2	1						3	1	
CO4	3					2	1						3	1	
CO5	3					2	1						3	1	
	3	High				2	Medium					1	Low		

Assessment	**Marks**	**Weightage**	**Marks**	**IAE Marks**	**FE**	**Total Marks**
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video presentation/Assignment	10	5				
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