EXCEL ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

Accredited by NBA, NAAC with "A+" and Recognised by UGC (2f &12B)

KOMARAPALAYAM – 637303

DEPARTMENT OF AERONAUTICAL ENGINEERING

B.E. AERONAUTICAL ENGINEERING
I TO VIII SEMESTER CURRICULUM

REGULATION 2020

I SEMESTER									
Code No.	Course	Category	Periods / Week			Credits	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Courses									
20MA105	Mathematics-I for Mechanical Sciences	BS	3	2	0	4	40	60	100
20AE101	Fundamentals of Aeronautics	ES	3	0	0	3	40	60	100
20EC103	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	40	60	100
Theory with Practical Courses									
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	0	100
TOTAL			**15**	**2**	**8**	**20**	**370**	**330**	**700**

*** Language Electives – I**

Code No.	Course	Category	Periods / Week			Credits	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

II SEMESTER									
Code No.	Course	Category	Periods / Week			Credits	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Courses									
20MA205	Mathematics – II for Mechanical Sciences	BS	3	2	0	4	40	60	100

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20ME201	Engineering Mechanics	ES	3	2	0	4	40	60	100
Theory with Practical Courses									
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									
20AE201	Aeronautical Engineering Practices Laboratory	ES	0	0	2	1	50	50	100
Mandatory Course									
20MC201	Environmental Sciences	MC	2	0	0	0	50	50	100
Total			**16**	**4**	**8**	**20**	**330**	**370**	**700**

****Language Electives – II**

Code No.	Course	Category	Periods / Week			Credits	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**			**Credits**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Courses									
20MA301	Transforms and Boundary Value Problems	BS	3	2	0	4	40	60	100
20AE301	Aero Engineering Thermodynamics	PC	3	0	0	3	40	60	100
20AE302	Engineering Materials and Metallurgy	PC	3	0	0	3	40	60	100
20AE303	Manufacturing Technology	ES	3	0	0	3	40	60	100
Theory with Practical Courses									
20AE304	Fluid Mechanics and Machinery for Aeronautical Engineers	ES	3	0	2	4	50	50	100
20AE305	Strength of Materials for Aeronautical Engineers	ES	3	0	2	4	50	50	100
Practical Course									

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20AE306	Applied Thermodynamics Laboratory	ES	0	0	2	1	50	50	100
Mandatory Course									
20MC302	Interpersonal Skills	MC	0	0	2	0	100	0	100
Total			**18**	**2**	**8**	**22**	**410**	**390**	**800**

IV SEMESTER

Code No.	Course	Category	Periods / Week			Credits	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Courses									
20MA401	Numerical Analysis and Statistics	BS	3	2	0	4	40	60	100
20AE401	Aircraft Structural Mechanics	PC	3	0	0	3	40	60	100
20AE402	Aircraft Propulsion	PC	3	0	0	3	40	60	100
20AE403	Aircraft Systems and Instruments	PC	3	0	0	3	40	60	100
20AE404	Mechanics of Machinery	PC	3	0	0	3	40	60	100
Theory with Practical Courses									
20AE405	Aerodynamics	PC	3	0	2	4	50	50	100
Practical Course									
20AE406	Propulsion Laboratory	PC	0	0	2	1	50	50	100
20AE407	Computer Aided Aircraft Components Drawing Laboratory	PC	0	0	2	1	50	50	100
Mandatory Course									
20MC401	Soft skill	HSS	2	0	0	0	100	0	100
Total			**20**	**2**	**6**	**22**	**450**	**450**	**900**

V SEMESTER

Code No.	Course	Category	Periods / Week			Credits	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Courses									
20AE501	Flight Dynamics	PC	3	2	0	4	40	60	100
20AE502	Rocket and Space Propulsion	PC	3	2	0	4	40	60	100
20AE503	Compressible Flow Aerodynamics	PC	3	0	0	3	40	60	100
20YYOXX	Open Elective - I	OE	3	0	0	3	40	60	100
20AEEXX	Professional Elective-I	PE	3	0	0	3	40	60	100

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Theory with Practical Courses									
20AE504	Aircraft Structural Analysis	PC	3	0	2	4	50	50	100
Practical Courses									
20AE505	Aero engine & Airframe Laboratory	PC	0	0	2	1	50	50	100
Total			**18**	**4**	**4**	**22**	**300**	**400**	**700**

VI SEMESTER

Code No.	Course	Category	Periods / Week			Credits	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Courses									
20AE601	Finite Element Methods	PC	3	2	0	4	40	60	100
20AE602	Composite Materials and Structures	PC	3	0	0	3	40	60	100
20AE603	Professional Ethics in Engineering	PC	3	0	0	3	40	60	100
20YYOXX	Open Elective-II	OE	3	0	0	3	40	60	100
20AEEXX	Professional Elective – II	PE	3	0	0	3	40	60	100
Theory with Practical Courses									
20AE604	UAV Systems	PC	3	0	2	4	50	50	100
Practical Courses									
20AE605	Analysis and Simulation Laboratory	PC	0	0	2	1	50	50	100
20AE606	Mini project	EEC	0	0	2	1	50	50	100
20AE607	Internship	EEC	2 Weeks			1	100	0	100
Total			**18**	**2**	**6**	**23**	**450**	**450**	**900**

VII SEMESTER

Code No.	Course	Category	Periods / Week			Credits	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Courses									
20AE701	Computational Fluid Dynamics	PC	3	0	0	3	40	60	100
20AE702	Innovation & Entrepreneurship	EEC	3	0	0	3	40	60	100
20AE703	Aircraft Design	PC	3	0	0	3	40	60	100
20YYOXX	Open Elective - III	OE	3	0	0	3	40	60	100
20AEEXX	Professional Elective – III	PE	3	0	0	3	40	60	100
20AEEXX	Professional Elective – IV	PE	3	0	0	3	40	60	100
Practical Courses									

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20AE704	Aircraft Systems & Flight simulator Laboratory	PC	0	0	2	1	50	50	100
20AE705	Design Project	EEC	0	0	2	1	50	50	100
Total			**18**	**0**	**4**	**20**	**340**	**460**	**800**

VIII SEMESTER

Code No.	Course	Category	Periods / Week			Credits	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Courses									
20AEEXX	Professional Elective – V	PE	3	0	0	3	40	60	100
20AEEXX	Professional Elective – VI	PE	3	0	0	3	40	60	100
Practical Course									
20AE801	Major Project	EEC	0	0	20	10	150	150	300
Total			**6**	**0**	**20**	**16**	**230**	**270**	**500**

PROFESSIONAL ELECTIVE

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
STREAM – 1 AERODYNAMICS								
1	20AEE01	Low speed Aerodynamics	PE	3	3	0	0	3
2	20AEE02	High speed Aerodynamics	PE	3	3	0	0	3
3	20AEE03	Boundary Layer Theory	PE	3	3	0	0	3
4	20AEE04	Viscous Flow Theory	PE	3	3	0	0	3
5	20AEE05	Industrial Aerodynamics	PE	3	3	0	0	3
6	20AEE06	Aero Acoustics	PE	3	3	0	0	3
7	20AEE07	Flight Instrumentation	PE	3	3	0	0	3
8	20AEE08	Air Traffic Control and Planning	PE	3	3	0	0	3
9	20AEE09	Behavior of Material at High Temperature	PE	3	3	0	0	3
10	20AEE10	Experimental Aerodynamics	PE	3	3	0	0	3
11	20AEE11	Helicopter Aerodynamics	PE	3	3	0	0	3
12	20AEE12	Civil Aviation Requirements	PE	3	3	0	0	3
13	20AEE13	Aircraft Rules and Regulations	PE	3	3	0	0	3
STREAM – 2 PROPULSION								
14	20AEE21	Space Mechanics	PE	3	3	0	0	3
15	20AEE22	Cryogenic Engineering	PE	3	3	0	0	3
16	20AEE23	Heat transfer	PE	3	3	0	0	3
17	20AEE24	Aircraft Cooling Systems	PE	3	3	0	0	3
18	20AEE25	Combustion Modeling	PE	3	3	0	0	3
19	20AEE26	Micro Propulsion System	PE	3	3	0	0	3
20	20AEE27	Aero engine control system	PE	3	3	0	0	3
21	20AEE28	Rockets and Missiles	PE	3	3	0	0	3

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22	20AEE29	High Temperature Gas Dynamics	PE	3	3	0	0	3
23	20AEE30	Wind Tunnel Techniques	PE	3	3	0	0	3
24	20AEE31	Missiles Guidance	PE	3	3	0	0	3
25	20AEE32	High Temperature Materials	PE	3	3	0	0	3
STREAM – 3 AIRCRAFT STRUCTURE AND DESIGN								
26	20AEE41	Optimization and its applications	PE	3	3	0	0	3
27	20AEE42	Fatigue and fracture	PE	3	3	0	0	3
28	20AEE43	Failure analysis	PE	3	3	0	0	3
29	20AEE44	Aircraft Structural Testing and Qualification	PE	3	3	0	0	3
30	20AEE45	Experimental Technology for Aircraft Structures	PE	3	3	0	0	3
31	20AEE46	Vibration and Rotor dynamics	PE	3	3	0	0	3
32	20AEE47	Experimental stress analysis	PE	3	3	0	0	3
33	20AEE48	Aircraft Structural health Monitoring Systems	PE	3	3	0	0	3
34	20AEE49	Nano Composite Materials	PE	3	3	0	0	3
35	20AEE50	Hyper mesh	PE	3	3	0	0	3
36	20AEE51	Helicopter Theory and Maintenance	PE	3	3	0	0	3
37	20AEE52	Airframe maintenance and repair	PE	3	3	0	0	3
38	20AEE53	Aero engine maintenance & repair	PE	3	3	0	0	3
39	20AEE54	Theory of Elasticity	PE	3	3	0	0	3
40	20AEE55	Advanced Manufacturing Process	PE	3	3	0	0	3
41	20AEE56	Design for manufacture and assembly	PE	3	3	0	0	3
42	20AEE57	Total Quality management	PE	3	3	0	0	3
43	20AEE58	Production planning and control	PE	3	3	0	0	3
44	20AEE59	Six sigma and Lean concepts	PE	3	3	0	0	3
45	20AEE60	Nondestructive testing	PE	3	3	0	0	3
46	20AEE61	Computer Integrated Manufacturing	PE	3	3	0	0	3

OPEN ELECTIVES

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
OPEN ELECTIVE								
1	20AEO01	Drone Design and development	OE	3	3	0	0	3
2	20AEO02	Helicopter Technology	OE	3	3	0	0	3
3	20AEO03	Air traffic control	OE	3	3	0	0	3
4	20AEO04	Automobile Aerodynamics	OE	3	3	0	0	3
5	20AEO05	Avionics	OE	3	3	0	0	3
6	20 AEO06	Aircraft Power Plant	OE	3	3	0	0	3

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7	20 AEO07	Basics of Aeronautical Science	OE	3	3	0	0	3
8	20 AEO08	Airport Management	OE	3	3	0	0	3
9	20 AEO09	Rocket and Space Science	OE	3	3	0	0	3
10	20 AEO10	Aircraft Maintenances	OE	3	3	0	0	3

ONE CREDIT COURSES

S. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	20AEA01	Wind Turbine Design and Testing	EEC	15	1	0	0	1
2	20AEA02	Real Time Industrial Applications in CFD	EEC	15	1	0	0	1
3	20AEA03	Failure Analysis of Advanced Composites	EEC	15	1	0	0	1
4	20AEA04	Technical Documentation for Aerospace Engineering Services	EEC	15	1	0	0	1
5	20AEA05	Introduction to Aerospace Navigation	EEC	15	1	0	0	1
6	20AEA06	Disruptive Innovation Based Startup Activities	EEC	15	1	0	0	1

CREDITS DISTRIBUTION – SEMESTER WISE

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT (AICTE)	CREDITS in %
		I	II	III	IV	V	VI	VII	VIII		
1	**HSS**	3	3		0					**6 (10-14)**	**3.63 %**
2	**BS**	8	8	4	4					**24 (22-28)**	**14.55%**
3	**ES**	9	9	12						**30 (24)**	**18.18 %**
4	**PC**			6	18	16	15	7		**62 (48)**	**37.57%**
5	**PE**					3	3	6	6	**18 (18)**	**10.90%**
6	**OE**					3	3	3		**9**	**5.45%**
7	**EEC**						2	4	10	**16 (12-16)**	**9.70%**
8	**MC**	0	0	0						**0**	**0**
Total		20	20	22	22	22	23	20	16	**165**	**100.00 %**

HSS - Humanities and Social Sciences
BS - BasicSciences
ES - Engineering Sciences
PC - ProfessionalCore
PE - Professional Electives

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OE - OpenElectives
EEC - Employability Enhancement Courses
MC - Mandatory Courses (Non-Credit Courses)
CA - Continuous Assessment
FE - Final Examination

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Semester - I

20MA105	Mathematics-I for Mechanical Sciences (Common to AERO, MECH and SAFETY & FIRE)	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 polar co-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", 44th Edition, Khanna Publishers, 2016.
2. Veerarajan.T, "Engineering Mathematics for Semester I and II", 3rd Edition, Tata McGraw Hill, 2014.

Reference Books:

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

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20AE101	Fundamentals of Aeronautics	L	T	P	C
		3	0	0	3
Nature of Course	Engineering Sciences				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Understand the Historical evaluation of Airplanes
2. Study the different component systems and Instruments functions
3. Understand the basic properties and principles behind the flight
4. Study the various types of power plants used in aircrafts
5. Study the different Structures & Construction

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Learn the history of aircraft & developments over the years.	Understand
CO2	Ability to identify the types & classifications of components and control systems.	Understand
CO3	Understand the basic concepts of flight & Physical properties of Atmosphere.	Understand
CO4	Demonstrate the various propulsion units used to achieve thrust in the atmosphere and space operated vehicles. Different types of Engines and principles of Rocket.	Analysis
CO5	An ability to differentiate the types of fuselage and constructions.	Understand

Course contents:

UNIT - I Evolution and History of Flights **9**

History and classifications of airplanes-Balloonflight-Ornithopers-Early Airplanes by Wright Brothers-biplanes-monoplanes-Anatomy of Helicopters and Rockets Developments in aerodynamics-materials-Structures and Propulsion over the years

UNIT - II Aircraft Configurations and Instruments **9**

Components of an airplane and their functions -Conventional control-powered control- Flight Instruments and Navigation Instruments – Gyroscope - Accelerometers, Air speed Indicators – TAS, EAS- Mach Meters - Altimeters - Principles and operation

UNIT - III Basics of Aerodynamics **9**

Study of Atmospheres Temperature, pressure and altitude relationships -Aerodynamic Forces of aircraft-Lift- Drag- Moment - Classifications of aerofoils, Mach number

UNIT - IV Basics of Propulsion **9**

Basic ideas about Piston-Turboprop and jet engines – Use of propeller and jets for thrust production- Principle of Operation of rocket- types of rocket and typical applications- Introduction Space vehicles operations.

UNIT - V Basics of Aircraft Structures and Materials **9**

General types of construction, Monocoque, semi-Monocoque and geodesic constructions, typical wing and fuselage structure-Metallic and non-metallic materials- Use of Aluminium Alloy- titanium-stainless steel and composite materials.

Total: 45 Periods

Text books

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1. Anderson, J.D., “Introduction to Flight”, McGraw-Hill; 8th edition, 2015.
2. Stephen. A. Brandt, “Introduction to Aeronautics”: A design perspective, 2nd edition, AIAA Education Series, 2004.

References

1. Kermode, A.C., “Mechanics of Flight”, Himalayan Book, 11th edition, 1997.
2. "Flight without Formulae", McGraw Hill, 4th Edition, 1997.
3. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, 2nd Edition, Standard Publishers Distributors, Delhi, 2008.
4. Pallet, E.H.J., “Aircraft Instruments & Principles”, Pitman & Co., 2nd Edition, 1992.

Web References

1. https://nptel.ac.in/content/storage2/courses/101106035/003_Chapter%201_L3_(04-10-2013).pdf
2. https://nptel.ac.in/content/storage2/courses/101106035/002_Chapter%201_L2_(01-10-2013).pdf
3. https://nptel.ac.in/courses/101/101/101101079/
4. https://nptel.ac.in/courses/101/101/101101083/
5. https://nptel.ac.in/courses/101/105/101105084/

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	-	-	2	1	1	-	-	1	2	2	1	-
CO2	3	-	1	1	-	2	1	1	-	-	1	2	2	1	-
CO3	3	-	1	1	-	2	1	2	-	-	1	2	2	1	-
CO4	2	-	1	1	1	2	1	1	-	-	1	1	2	1	-
CO5	1	-	-	1	1	2	1	2	-	-	1	1	1	-	-
	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 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
Analyze				
Evaluate				
Create				

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20EC103	Basics of Electrical and Electronics Engineering (Common to Aeronautical, Mechanical, Safety and Fire Engineering & Food Technology)	L	T	P	C
		3	0	0	3
Nature of Course	**Engineering Sciences**				
Pre requisites	Nil				

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 wiringand 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

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Text Books

1. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics ", S. Chand & Co. Ltd., 2008.
2. D P Kothari and I.J Nagarath, "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. T.K.Nagsarkar and M.S.Sukhija, "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. V. D. Toro, "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
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

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 CO2, 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 supplied.

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).

Total: 45 Periods

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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	Conduct metric 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 pent hydrate	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,2nd Edition, New Delhi, 2017.
2. P.C.Jain and Monicka Jain, "Engineering Chemistry",DhanapatRaiPublishing Company Pvt. Ltd, 11th Edition, 2017.

Reference Books

1. B.Sivasankar"Engineering Chemistry"TataMcGraw – HillPub.Co.Ltd, New Delhi, 2ndEdition, 2009.
2. R.Sivakumar and N. Sivakumar,"Engineering Chemistry"TataMcGraw-Hill Pub.Co.Ltd,New Delhi, 1st Edition,2009.
3. Dr.Sivanesanand 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 (CO) with Programme Outcomes (PO) and 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													
CO2	3	2													
CO3	3	2													
CO4	3	2													
CO5	3	2													
	3	High				2	Medium					Low			

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

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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				
Pre requisites	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 Surfaces (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

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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.
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			

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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 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 course				
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 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 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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II SEMESTER

20MA205	Mathematics– II for Mechanical Sciences (Common to AERO, MECH and SAFETY & FIRE)	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

Text Books:

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

Reference Books:

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

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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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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**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	20	20	20	40
Analyse				
Evaluate	10	10	10	20
Create				

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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. Understand 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, and mode) – optical fiber communication system- fiber optic endoscope.

UNIT III Thermal Physics **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 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 New Engineering Materials **9**

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Metallic glasses – preparation, properties and applications – Shape memory alloys – Types, characteristics and applications – Nanomaterials – 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 - Ultrasonic interferometer	CO1	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", 2nd edition, Oxford University Press, 2015.
2. M.N. Avadhanulu, M.N. & Kshirsagar PG. "A Text book of Engineering Physics", 10th edition, S.Chand and company, Ltd., New Delhi, 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/

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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	1	1												
CO2	3	1	1												
CO3	3	1	1												
CO4	3	1	1												
CO5	3		1												
	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	

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	10	10	10		-	20
Understand	35	35	35		40	70
Apply	5	5	5		60	10
Analyse	-	-	-		-	-
Evaluate	-	-	-		-	-
Create	-	-	-		-	-

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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

1. To think logically and write algorithm and draw flow charts for problems.
2. To read and write simple Python programs.
3. To develop Python programs with conditionals and loops.
4. To define Python functions and call them.
5. To 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

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

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Laboratory Components

S. No.	List of Experiments	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

Text Books:

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

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 (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	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		

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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 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	10	10	10			20
Understand	20	20	20		30	50
Apply	20	20	20		50	30
Analyse	-	-	-		20	-
Evaluate	-	-	-		-	-
Create	-	-	-		-	-

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20AE201	Aeronautical Engineering Practices Laboratory	L	T	P	C
		0	0	2	1
Nature of Course	Engineering Science				
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 do

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

Laboratory Components

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

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings	15 Sets.
2.	Carpentry vice (fitted to work bench)	15 Nos
3.	Standard woodworking tools	15 Sets.
4.	Arc welding transformer with cables and holders	5 Nos
5.	Welding booth with exhaust facility	5 Nos
6.	Welding accessories like welding shield, chipping hammer, wire brush, etc	5 Nos
7.	Moulding table, foundry tools	2 sets
8.	Hand Drilling Machine	1 Nos

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									2			
CO3			3									2			
CO4			3									2			
CO5			3									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		

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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 Course				
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

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

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Total: 30 periods

TextBooks

1. AnubhaKaushik 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 andRajeshwariGarg“Ecological and Environmental Studies”,Khanna Publishers, NaiSarak, 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

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		

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 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
Analyze				
Evaluate				
Create				

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Language Elective - I

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

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	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 Communication 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 Communication 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

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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
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.

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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**			

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 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
Analyze						
Evaluate						
Create						

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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: 30Periods

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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. 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,10thEdition,2007.
2. John CunnisonCatford, “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. DhanavelS. P., “English and Soft Skills”, 1stEdition, Orient Black Swan Private Limited, Hyderabad, 1st Edition, 2010.

Web reference:

1. https://www.coursera.org/lecture/tesol-speaking/video-2-listening-strategies-for-learners-3AeBL?utm_source=mobile&utm_medium=page_share&utm_content=vlp&utm_campaign=top_button
2. blob:https://www.youtube.com/73f7256d-d302-4563-bed5-9e84c94a26ac

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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	1	2	2		
CO2										3	1	2	2		
CO3										3	1	2	2		
CO4										3	1	2	2		
CO5										3	1	2	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 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						

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Language Elective – II

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.

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Total: 30Periods

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. 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,10thEdition,2007.
2. John CunnisonCatford, “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. DhanavelS. P., “English and Soft Skills”, 1stEdition, Orient Black Swan Private Limited, Hyderabad, 1st Edition, 2010.

Web reference:

1. https://www.coursera.org/lecture/tesol-speaking/video-2-listening-strategies-for-learners-3AeBL?utm_source=mobile&utm_medium=page_share&utm_content=vlp&utm_campaign=top_button
2. blob:https://www.youtube.com/73f7256d-d302-4563-bed5-9e84c94a26ac

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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	1	2	2		
CO2										3	1	2	2		
CO3										3	1	2	2		
CO4										3	1	2	2		
CO5										3	1	2	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 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						

CHAIRMAN - BOARD OF STUDIES

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
CO1	Construct simple sentences and use vocabulary required for day-to- day conversation	Remember
CO2	Distinguish and understand the basic sounds of Hindi language.	Remember
CO3	Appear for Hindi examinations conducted by Dakshin Bharat Hindi Preacher Sabha.	Remember
CO4	Distinguish the words used in daily life	Remember
CO5	Express individual opinion and speak fluently in Hindi	Remember

Course Contents:

UNIT I: Introduction **6**

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - vowel 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.

UNITI V: 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 Preacher Vahini-1 by Dakshin Bharat Hindi Preacher Sabha Chennai
2. B.R.Kishore, Self Hindi Teacher for Non-Hindi Speaking People, VeeKumar Publications(P)Ltd., NewDelhi,2009
3. Videos, Stories, Rhymes andSongs.

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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	1	2	2		
CO2										3	1	2	2		
CO3										3	1	2	2		
CO4										3	1	2	2		
CO5										3	1	2	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 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						

CHAIRMAN - BOARD OF STUDIES

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 DELFA1 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	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''informersur 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 libreet les loisirs, les saisons, les activitesquotidiennes, le temps (lematin, le soir, lanuit)

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

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UNIT V: Gouter ALa 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 (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										2					
CO2										2					
CO3										3					
CO4										3					
CO5										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 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						

CHAIRMAN - BOARD OF STUDIES

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:

UNITI Introduction **6**

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

UNITII Pronunciation **6**

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

UNIT III Basic Syntax **6**

Regular & Irregular verbs - Personal pronouns - family - Introduction to type's of sentences

UNITIV 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 ALSFREMDSPRACHE,Goyal Publishers & Distributers Pvt. Ltd., NewDelhi,2015
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., NewDelhi,2009
3. Grundkurs, DEUTSCH LehrbuchHueber Munichen,2007

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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										2					
CO2										2					
CO3										3					
CO4										3					
CO5										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 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						

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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, Building and Bio 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, 2) -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

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Text Books:

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

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**
	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				

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20AE301	Aero Engineering Thermodynamics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Engineering Physics				

Course Objectives

The course is intended to

1. To study Thermodynamics quantitative analysis of machine and processes for transformation of energy and between work and heat.
2. To learn Laws of thermodynamics would be able to quantify through measurement of related properties, to these energies and their interactions.
3. To introduce basic concept of air cycle and introduce the concept of a pure substance, vapour cycles.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.	Apply
CO2	Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.	Apply
CO3	Apply thermodynamic concepts to different air standard cycles and solve problems.	Apply
CO4	Illustrate the importance of steam for heat transfer, Construct phase and phase changes processes of pure substances	Understand
CO5	Apply Rankine cycle to steam power plant and compare few cycle improvement methods.	Apply

Course contents:

UNIT I Fundamental Concept and First Law **9**

Concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, internal energy, enthalpy, specific heat capacities and heat transfer, SFEE, application of SFEE to jet engine components, First law of thermodynamics, relation between pressure, volume and temperature for various processes, Zeroth law of thermodynamics.

UNIT II Second Law and Entropy **9**

Second law of thermodynamics-Kelvin Planck and Clausius statements of second law, Reversibility and Irreversibility, Thermal reservoir, Carnot theorem, Carnot cycle, Reversed Carnot cycle, efficiency, COP, Clausius inequality and Concept of entropy

UNIT III Air Standard Cycles **10**

Otto, Diesel, Dual, and Brayton cycles - air standard efficiency - mean effective pressure.

UNIT IV Introduction and Properties of Pure Substance **8**

Properties of pure substances - solid, liquid and vapour phases, phase rule, p-v, p-T, T-v, T-s, h-s diagrams, p-v-T surfaces, thermodynamic properties of steam - calculations of work done and heat transfer in non-flow and flow processes.

UNIT V Vapour Power Cycles **9**

Problems on Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles

TOTAL: 45 PERIODS

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(Use of Standard and approved Steam Table and Mollier Chart permitted)

TEXT BOOKS:

1. Nag.P.K. “Engineering Thermodynamics”, Tata McGraw-Hill, New Delhi, 6th Edition 2017.
2. R.K.Rajput, “A Text Book of Engineering Thermodynamics “5th Edition, 2017.
3. Yunus A. Cengel and Michael A. Boles, “Thermodynamics: An Engineering Approach” McGraw-Hill Science/Engineering/Math; 9th Edition 2017.

REFERENCES:

1. Rajput. R.K, “Thermal Engineering” S.Chand publishers, 2017
2. Borgnakke & Sonnatag, “Fundamental of Thermodynamics”, 8th Edition, 2016.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Michael J. Moran, Howard N. Shapiro, “Fundamentals of Engineering Thermodynamics”, 8th Edition
5. Holman.J.P. “Thermodynamics”, 3rd Edition, McGraw-Hill, 2007.

ADDITIONAL REFERENCES:

1. https://nptel.ac.in/courses/112/105/112105123/
2. https://www.youtube.com/watch?v=94kWpTURhVU
3. https://www.youtube.com/watch?v=b5SPb6NHna4

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	-	-	-	-	-	-	-	2	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO5	3	3	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 (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AE302	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 science				

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

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Text Books

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

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 AnishUpadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.

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				

CHAIRMAN - BOARD OF STUDIES

20AE303	Manufacturing Technology	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Engineering physics, Chemistry				

Course Objectives:

1. Study the sand mould casting and special casting processes.
2. Learn various metal joining processes and applications.
3. Provide the information on machine tools and machining operations.
4. Rendering information on types of plastic and their forming processes.
5. Knowledge on metal forming processes and powder metallurgy.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Apply the knowledge on metal casting processes in the industry.	Understand
CO2	Discuss the practices on welding equipment's and its processes to join metals.	Understand
CO3	Classify and explain the machine tools and machining operations.	Understand
CO4	Explain the various types of plastics in industrial applications.	Understand
CO5	Utilize the knowledge and importance of metal forming process and powder metallurgy.	Understand

Course Contents:

UNIT I Casting **9**

Casting types, procedure to make sand mould, types of core making, moulding tools, special moulding processes - CO_2 moulding, shell moulding, investment mounding, pressure die casting, centrifugal casting, continuous casting, casting defects

UNIT II Welding **9**

Classifications - Principles of Oxy-acetylene gas welding, Metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, Electron beam welding, laser beam welding, defects in welding, soldering and brazing.

UNIT III Machining **10**

Principles and operations - Lathe, Shaper, Planer, Milling, Drilling and Grinding machines, Capstan and Turret lathe, Basics of CNC machines. Principles and applications - Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining.

UNIT IV Forming and Shaping of Plastics **9**

Classifications and characteristics of plastics, Moulding of Thermoplastics, Principles and applications - Injection moulding, Plunger and screw machines, Blow moulding, Rotational moulding, Film blowing, Extrusion and Thermoforming, Processing of Thermosets, Principles and applications - Compression and Transfer moulding.

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UNIT V Metal Forming and Powder Metallurgy **8**

Principles and applications - Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy - principal steps involved, advantages and limitations

TOTAL: 45 PERIODS

Text books:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2018.
2. NagendraParashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hall of India Private Limited, 2011.

References:

1. Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", Fourth Edition, Pearson Education, Inc. 2018.
2. "H.M.T. Production Technology - Handbook", Tata McGraw-Hill, 2017.
3. Adithan. M and Gupta. A.B., "Manufacturing Technology", New Age, 2012.
4. Jain. R.K. and S.C. Gupta, "Production Technology", Khanna Publishers. 19th Edition.2012
5. Roy. A. Linberg, "Process and Materials of Manufacture", PHI, 2011.

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	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO5	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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AE304	Fluid Mechanics and Machinery for Aeronautical Engineers	L	T	P	C
		3	0	2	4
Nature of Course	Engineering Sciences				
Pre requisites	Engineering Physics				

Course Objectives

The course is intended to

1. To learn the properties of fluids and the concept of control volume.
2. To learn applications of the conservation laws to flow through pipes.
3. To Understand the importance of dimensional analysis
4. To understand the importance of various types of flow in pumps.
5. To 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
CO1	Apply mathematical knowledge to predict the properties and characteristics of a fluid.	Apply
CO2	Analyze and calculate major and minor losses associated with pipe flow in piping networks.	Analyze
CO3	Predict the nature of physical quantities.	Understanding
CO4	Analyze the performance of pumps.	Analyze
CO5	Analyze the performance of turbines.	Analyze

Course contents:

UNITI Fluid Properties and Flow Characteristics **9**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics - concept of control volume - application of continuity equation, energy equation and momentum equation.

UNITII Flow through Circular Conduits **9**

Hydraulic and energy gradient - Laminar flow through circular conduits circular annuli- Boundary layer concepts - types of boundary layer thickness - Darcy Weisbach equation - friction factor- Moody diagram- commercial pipes- minor losses - Flow through pipes in series and parallel.

UNITIII Dimensional Analysis **9**

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

UNITIV Pumps **9**

Imp of jets - Euler's equation- velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps- working principle - work done by the impeller - performance curves - Reciprocating pump- working principle - Rotary pumps-classification.

UNITV Turbines **9**

Classification of turbines - heads and efficiencies - velocity triangles, Axial, radial and mixed flow turbines, Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner - draft tube. Specific speed - unit quantities - performance curves for turbines - governing of turbines.

TOTAL: 45PERIODS

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Laboratory Components

S. No.	Exercises	CO Mapping	Blooms Level
1	Determination of the Coefficient of discharge of a given Orifice meter.	1	Apply
2	Determination of the Coefficient of discharge of a given Venturi meter.	2	Apply
3	Calculation of the rate of flow using Rotameter.	2	Apply
4	Determination of friction factor for a given set of pipes.	2	Apply
5	Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump.	3	Apply
6	Conducting experiments and drawing the characteristic curves of reciprocating pumps.	3	Apply
7	Conducting experiments and drawing the characteristic curves of Gear pump.	3	Apply
8	Conducting experiments and drawing the characteristic curves of the Pelton wheel.	4	Apply
9	Conducting experiments and drawing the characteristics curves of Francis turbine.	4	Apply
10	Conducting experiments and drawing the characteristic curves of Kaplan turbines.	4	Apply

TOTAL: 30PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	QUANITY
1	Orifice meter set up	1
2	Venturi meter set up	1
3	Rota meter set up	1
4	Pipe flow analysis set up	1
5	Centrifugal pump / Submergible pump set up	1
6	Reciprocating pump set up	1
7	Gear pump set up	1
8	Pelton wheel set up	1
9	Francis turbine set up	1
10	Kaplan turbine set up	1

Text Books:

1. Dr.P.N.Modi, S.M.Seth Hydraulics and Fluid Mechanics Including Hydraulics Machines, Rajsons Publications Pvt Ltd, Paperback 22nd Edition 2019.
2. R.K.Bansal, A Textbook Of Fluid Mechanics And Hydraulic Machines, Lakshmi Publications, 10th Edition 2018,

References:

1. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House (p) Ltd., New Delhi,2016.
2. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.
3. Robert W. Fox, Alan T. McDonald, Philip J.Pritchard, “Fluid Mechanics and Machinery”, 2011.
4. Streeter, V.L.andWylieE.B.,"Fluid Mechanics", McGraw Hill Publishing Co.2010.

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Additional References:

1. http://www.springer.com/materials/mechanics/book/978-3-540-25141-5
2. https://nptel.ac.in/courses/105/103/105103192/

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											2	
CO2	3	2	3											2	
CO3	3	2	3											2	
CO4	3	3	2											2	
CO5	3	2	3											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	

Theory with Practical

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

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20AE305	Strength of Materials for Aeronautical Engineers	L	T	P	C
		3	0	2	4
Nature of Course	Engineering Science				
Pre requisites	Engineering Mechanics				

Course Objectives

The course is intended to

1. Enable understanding of the behavior and response of materials
2. Draw shear force and bending moment diagram for beams with various loading and end conditions
3. Familiarize with the different methods used for beam deflection analysis
4. Give a theoretical design of shaft for the required working conditions and predictions of the response of the springs subjected to various loads.
5. Impart the Knowledge of bi-axial loading, stresses in cylinder and Mohr circle

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Apply materials and their elastic constants for composite bar subjected to various loads including thermal load.	Apply
CO2	Construct Shear Force, Bending moment and Bending stress distribution in beams subjected to Various loading and End Conditions.	Understand
CO3	Determine the deflection of beams using different methods.	Analyze
CO4	Apply the knowledge of torsion, spring, twist, spring to estimate deflection and spring constants.	Apply
CO5	Apply the knowledge of bi-axial loading cylinder burst pressure and Mohr circle to aircraft structural components.	Apply

Course contents:

UNIT – I Stress, Strains, Deformation of Solids and Elastic Constants **9**

Rigid bodies and deformable solids -Tension, Compression and Shear Stresses -Deformation of simple and compound bars -Thermal stress -Elastic constants -Volumetric strains.

UNIT – II Transverse loading and Stresses in Beams **9**

Beams -types transverse loading on beams -Shear force and bending moment in beams - Cantilevers - Simply supported beams and over -hanging beams. Theory of simple bending-bending stress distribution

UNIT – III Beam Deflection **9**

Double Integration method -Macaulay's method -Area moment method for computation of slopes and deflections in beams - Conjugate beam method

UNIT – IV Torsion, springs and Shafts **9**

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.

UNIT – V Thick and Thin Walled Cylinders **9**

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. Stresses on inclined planes -principal stresses and principal planes -Mohr's circle of stress

TOTAL: 45 PERIODS

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Laboratory Components

S. No.	Exercises	CO Mapping	Blooms Level
1	Determination of Young's Modulus using deflection of Cantilever beam	1,3	Apply
2	Determination of Young's Modulus using deflection of Simply supported beam	1,3	Apply
3	Determination of Young's modulus and fracture strength of steel using UTM.	1,3	Apply
4	Torsion test on Mild Steel Rod	3	Apply
5	Verification of Maxwell's Reciprocal theorem.	1,3	Apply
6	Determination of impact strength of a given material by Izod and Charpy test	5	Apply
7	Determination of different hardness of a material by Rockwell and Brinell method	2	Apply
8.	Compression test of a helical spring	4	Apply
9.	Tempering- Improvement Mechanical properties Comparison (i) Unhardened specimen (ii) Quenched Specimen and (iii) Quenched and tempered specimen	2,3	Apply
10.	Microscopic Examination of (i) Hardened samples and (ii) Hardened and tempered samples	2,3	Apply

TOTAL: 30 PERIODS

List of Equipment for a Batch of 30 Students

S.No.	Name of the equipment	Quantity	Experiment No.
1.	Universal Tensile Testing machine with double 1 shear attachment - 40 Ton Capacity	1	3
2.	Torsion Testing Machine (60 NM Capacity)	1	4
3.	Impact Testing Machine (300 J Capacity)	1	6
4.	Brinell Hardness Testing Machine	1	7,9,10
5.	Rockwell Hardness Testing Machine	1	7,9,10
6.	Metallurgical Microscopes	3	9,10
7.	Muffle Furnace (800 ^{0}C)	1	9,10
8.	Beam Test set up	3	1,2,3,5

Text books

1. R.K. Rajput," Strength of materials", Seventh Edition ,S. Chand Limited, 2018
2. R. K. Bansal, "A Text Book of Strength of Materials", Sixth Edition, Lakshmi Publications Pvt. Limited, New Delhi, 2012
3. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

References

1. James M. Gere, "Mechanics of Materials", 8th Edition, 2013.
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education series, 2010.
3. S. Timoshenko, "Strength of Materials", Vol. II, CBS Publishers, 2002.
4. Srinath L.S., "Advanced Mechanics of Solids", Tata McGraw-Hill Publishing Co., New Delhi, 2003

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Web References

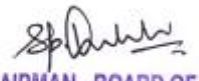
1. https://ocw.mit.edu/courses/mechanical-engineering/2-001-mechanics-materials-i-fall-2006/index.htm
2. http://nptel.ac.in/courses/112107146/
3. http://www.engineeringcorecourses.com/solidmechanics1/
4. http://www.springer.com/in/book/9783319061870
5. http://www.springer.com/in/book/9780278000520
6. https://onlinecourses.nptel.ac.in/noc17_ae04
7. http://nptel.ac.in/courses/101104067/

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	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	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	

Theory with Practical

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



CHAIRMAN - BOARD OF STUDIES

20AE306	Applied Thermodynamics Laboratory	L	T	P	C
		0	0	2	1
Nature of Course	Engineering Science				
Pre requisites	Engineering Physics				

Course Objectives

The course is intended

1. To study the characteristics of fuels / lubricates used in IC Engines.
2. To study the valve timing diagrams and performance of IC Engines.
3. To study the performance of refrigeration cycle / components.
4. To study the heat transfer phenomena predict the relevant coefficient using implementation.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Test on diesel / petrol engine.	Analyze
CO 2	Evaluate the performance of parallel / counter heat flow heat exchanger apparatus	Analyze
CO 3	Determine the properties of the fuels and solids.	Analyze
CO 4	Determine the thermal properties of composite walls.	Analyze
CO 5	Evaluate the performance of refrigeration and Air-conditioning test rig.	Analyze

Laboratory Components

S. No.	Exercises	CO Mapping	Blooms Level
1.	Performance test on a 4-stroke engine	CO1	Analyze
2.	Valve timing of a 4 - stroke engine	CO1	Understand
3.	Port timing of a 2 stroke engine	CO1	Understand
4.	Determination of effectiveness of a parallel flow heat exchanger	CO2	Analyze
5.	Determination of effectiveness of a counter flow heat exchanger	CO2	Analyze
6.	Determination of Flash point and Fire point of various fuels.	CO3	Understand
7.	Determination of thermal conductivity of solid.	CO4	Analyze
8.	Determination of thermal resistance of a composite wall.	CO4	Analyze
9.	COP test on a vapour compression refrigeration test rig	CO5	Analyze
10.	COP test on a vapour compression air-conditioning test rig	CO5	Analyze

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of the equipment	Quantity	Experiment No.
1.	4 stroke twin cylinder diesel engine	1	1
2.	Cut section model of 4 stroke diesel engine and cut section model of 2 stroke petrol engine	1	2
3.	Parallel and counter flow heat exchanger test rig	1	3,4
4.	Bomb Calorimeter	1	5,6
5.	Conductive heat transfer set up	1	7
6.	Composite wall	1	8
7.	Vapour compression refrigeration test rig	1	9
8.	Vapour compression air-conditioning test rig	1	10

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	-	-	-	-	2	-	-	-	2	-	-
CO2	3	3	3	3	-	-	-	-	2	-	-	-	2	-	-
CO3	3	3	3	3	-	-	-	-	2	-	-	-	2	-	-
CO4	3	3	2	3	-	-	-	-	2	-	-	-	2	-	-
CO5	3	3	2	3	-	-	-	-	2	-	-	-	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			
Analyze			
Evaluate	60	60	60
Create			

CHAIRMAN - BOARD OF STUDIES

20MC202	Interpersonal Skills	L	T	P	C
		2	0	2	0
Nature of Course	Mandatory, Non Credit				
Pre requisites	Communicative English				

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 of Interpersonal 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 -Nonverbal 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	Blooms Level
1	Self-Introduction	1	Remember
2	Presentation of Individual perception	2	Understand
3	Role play - Non-verbal communication - Body language	4	Apply
4	Role play - Interpersonal interactions &Assertive feedback	3	Remember
5	Group Discussion	4	Apply
6	Role play - Situational conversation (On spot)	5	Understand

Text Books

1. Floyd, Kory, "Interpersonal Communication", 2d. Boston: McGraw-Hill, 2nd Edition, 2011.
2. Bozeman, Jeanine C and Argile Smith, "Interpersonal Relationship Skills for Ministers" Gretna, LA: Pelican Publishing Company, 1st Edition, 2004.

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	2	1	2		
CO2										3	2	1	2		
CO3										3	2	1	2		
CO4										3	2	1	2		
CO5										3	2	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			
Analyze			
Evaluate	60	60	60
Create			

CHAIRMAN - BOARD OF STUDIES

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, Building and Bio 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

UNITIII 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.

UNITIV 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.

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

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

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	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	3	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	1	2	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	1	3	-	-
	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				

CHAIRMAN - BOARD OF STUDIES

20AE401	Aircraft Structural Mechanics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Engineering Mechanics and Strength of Materials				

Course Objectives

The course is intended to

1. Acquaint with the fundamentals of structural mechanics and analytical approaches for analysis of aircraft structures.
2. Learn about the energy methods in structural analyze.
3. Learn about linear elasticity and analyze the components subjected to typical aircraft loading conditions.
4. Introduce different failure theories to the aircraft structural problems.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Analyze statically determinate structures and indeterminate structures with different methods	Apply
CO2	Apply energy methods to determine slope and deflection of different structures	Apply
CO3	Analyze columns including beam column with various end conditions by Euler's theory and south well plot method.	Analyze
CO4	Apply different failure theories to analyze the aircraft structural problems.	Apply
CO5	Know about induced stresses in aircraft	understand

Course contents:

UNIT – I Statically Determinate and Indeterminate Structures **12**

Plane truss analysis- method of joints- method of sections - Clapeyrons 3 moment equation and moment distribution method for indeterminate beams

UNIT – II Energy Methods **12**

Strain Energy in axial, bending, torsion and shear loadings. Castigliano's theorems and their applications, Energy theorems-dummy load & unit load methods- energy methods applied to statically determinate and indeterminate beams.

UNIT – III Columns **12**

Column with various conditions- Rankins Column -effect of initial curvature- columns with eccentricity - theory of beam columns-beam columns with different end conditions-stresses in beam columns

UNIT – IV Failure Theories **12**

Ductile and brittle materials-maximum principal stress theory - maximum principal strain theory - maximum shear stress theory - distortion energy theory - octahedral shear stress theory

UNIT – V Induced Stresses **12**

Thermal stresses - impact loading- Fatigue- Creep - Stress Relaxation- corrosion.

TOTAL: 60 PERIODS

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Text books

1. 'Mechanics of Materials' by James M. Gere & Barry J Goodno, cengage Learning Custom Publishing 8th edition, 2012.
2. Megson T M G, `Aircraft Structures for engineering students' Butterworth-Heinemann publisher, 5th edition, 2012.

References

1. N.C. Pandya, C.S. Shah, "Elements of Machine Design", Charotar Publishing House, 15th edition, 2009
2. Donaldson, B.K., 'Analysis of Aircraft Structures - An Introduction' Cambridge University Press publishers, 2nd edition, 2008.
3. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999.
4. Bruhn E F, 'Analysis and Design of Flight Vehicle Structures', Tri-State Off-set Company, USA, 1985

Web References

1. http://nptel.ac.in/courses/112106141/
2. https://www.edx.org/course/introduction-to-aerospace-structures-and-materials
3. https://cosmolearning.org/courses/introduction-aerospace-structures/

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	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	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 (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AE402	Aircraft Propulsion	L	T	P	C
		3	0	0	3
Nature of Course	Components of gas turbine engines				
Pre requisites	Aero Engineering Thermodynamics				

Course Objectives
The course is intended to

1. Learn about the basic about piston and gas turbine engines
2. Study the functions of intakes and nozzles
3. Understand the working of combustion chamber
4. Study the efficiency of compressor through stages
5. Implement the knowledge about turbine principles and performance

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

CO. No.	Course Outcome	Bloom's Level
CO1	Describe about the basics of air breathing engines	Understand
CO2	Explain about the aircraft intakes and engine nozzles	Understand
CO3	Analyze the performance of combustion chamber	Analysis
CO4	Evaluate the purpose of compressor and its stage efficiency	Analysis
CO5	Examine the requirements of turbine for an aircraft	Understand

Course contents:

UNIT I Basics of Air Breathing Engines **9**

Introduction to piston engines - Illustration of working of gas turbine engines – characteristics - performance parameters - thrust equation - factors affecting thrust – methods of thrust augmentation

UNIT II Intakes and Nozzles **9**

Ram effect, Internal flow and Stall in subsonic inlets – relation between minimum area ratio and eternal deceleration ratio – diffuser performance – modes of operation - supersonic inlets – starting problem on supersonic inlets – shock swallowing by area variation – types of nozzles - losses in nozzles – thrust reversal

UNIT III Combustion Chambers **9**

Classification of combustion chambers –factors affecting – combustion chamber performance – effect of operating variables on performance – flame holders - flame stabilization - cooling process.

UNIT IV Compressors **9**

Principle operation of centrifugal and axial flow compressors – Work done and pressure rise – velocity diagrams – degree of reaction – free vortex and constant reaction designs of axial flow compressor – performance parameters – stage efficiency

UNIT V Turbines **9**

Impulse and reaction blading of gas turbines – Velocity triangles and power output – Elementary theory – Vortex theory – Choice of blade profile, pitch and chord – stage performance – Limiting factors - Overall turbine performance – blade cooling – Matching of turbine and compressor

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TOTAL: 45 PERIODS

Text book:

1. Ganesan V, “Gas Turbines” Tata McGraw-Hill, 3rd edition (2017).
2. Hill, P.G. & Peterson, C.R. “Mechanics & Thermodynamics of Propulsion” Pearson education (2009).

References:

1. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 2nd edition 2014.
2. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. “Gas Turbine Theory”, Pearson Education Canada; 6th edition, 2008.
3. “The Jet Engine”, Rolls Royce; 4th revised edition, 1986.
4. Oates, G.C., “Aero thermodynamics of Aircraft Engine Components”, AIAA Education Series, New York, 1985.

Web References:

1. https://nptel.ac.in/courses/112/103/112103281/
2. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-50-introduction-to-propulsion-systems-spring-2012/lecture-notes/
3. https://www.coursera.org/lecture/thermodynamics-intro/07-06-lets-look-inside-a-jet-engine-Ut UOI

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	1	2	2	1	-	-	-	-	-	2	1	3	2	3
CO2	2	2	3	2	3	-	-	-	1	-	2	1	3	2	3
CO3	2	2	3	2	3	-	-	-	1	-	2	1	3	2	3
CO4	2	2	3	2	3	-	-	-	1	-	2	1	3	2	3
CO5	2	2	3	2	3	-	-	-	1	-	2	1	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	

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AE403	Aircraft Systems and Instruments	L	T	P	C
		3	0	0	3
Nature of Course	Systems and Instruments used in Aircraft				
Pre requisites	Fundamentals of Aeronautics				

Course Objectives

The course is intended to

1. Know about the basic systems of an aircraft
2. Inculcate the control systems fundamentals and uses
3. Understand the working of engine systems
4. Study the aircraft comfort system that make the crew members safer
5. Learn the various engine instruments and its types

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Recapitulate the basic systems like hydraulic, pneumatic, braking and landing gear systems	Understand
CO2	Explain about the various control systems in an aircraft	Understand
CO3	illustrate the concepts of engine systems	Understand
CO4	Demonstrate the need of air conditioning and pressurizing systems	Analysis
CO5	Differentiate the engine instruments and its functions	Understand

Course contents:

UNIT I Aircraft Basic Systems **9**

Hydraulic system –– Pneumatic system – Brake system – Landing Gear System – Classification – Shock absorbers – Retractive mechanism

UNIT II Aircraft Control Systems **9**

Engine control system –Digital fly by wire system – Auto pilot system - Active Control Technology

UNIT III Aircraft Engine Systems **9**

Piston and Jet Engines- Fuel systems – Lubricating systems – Starting and Ignition systems

UNIT IV Air Conditioning and Pressurizing Systems **9**

Basic air cycle systems – Vapour cycle System - Boot-strap air cycle systems – Evaporative vapour and air cycle systems –– Oxygen system – Fire extinguishing and smoke detection systems - Deicing and anti-icing systems

UNIT V Aircraft Engine Instruments **9**

Study of various types of engine instruments – Principles and operation -Tachometers – Temperature and Pressure gauges

TOTAL: 45 PERIODS

Text Books:

1. Mekinley, J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill 1993.
2. Pallet, E.H.J. Aircraft Instruments & Principles, Pitman & Co 1993.

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References

1. Teager, S, “Aircraft Gas Turbine technology, McGraw Hill 1997.
2. Handbooks of Airframe and Power plant Mechanics, US dept. of Transportation, Federal, Aviation Administration, the English Book Store, New Delhi, 1995.
3. McKinley, J.L. and Bent R.D. Aircraft Maintenance & Repair, McGraw Hill, 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	2	3	2	-	1	1	-	-	2	1	2	1	-
CO2	3	3	3	3	3	-	1	1	-	-	2	1	2	1	-
CO3	3	2	2	3	2	-	1	1	-	-	2	1	2	1	-
CO4	3	2	2	3	2	-	1	1	-	-	2	1	2	1	-
CO5	3	2	3	3	3	-	1	1	-	-	2	1	1	-	-
	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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AE404	Mechanics of Machines	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 principles in the formation of mechanisms and their kinematics.
2. Know the effect of friction in different machine elements.
3. Importance of balancing and vibration.

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

CO. No.	Course Outcome	Bloom's Level
CO1	Apply the principles in the formation of mechanisms and their kinematics.	Understand
CO2	Explain the construction features of Gears and Gear Trains.	Understand
CO3	Analyze the effect of friction in different machine elements.	Analyze
CO4	Discuss the importance of balancing.	Understand
CO5	Analyze the vibration in different kind of machines.	Analyze

Course contents:

UNIT I Kinematics of Machines **9**
Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration diagram – Cam and followers – classifications – displacement diagrams (Simple Harmonic Motion) - layout of plate cam profiles – derivatives of followers motion.

UNIT II Gears and Gear Trains **9**
Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains.

UNIT III Friction **9**
Types of friction – Friction Drives -friction in screw threads – bearings – Friction clutches – Belt drives – Basics of Tribology.

UNIT IV Balancing and Mechanism For Control **9**
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines -Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines.

UNIT V Vibration **9**
Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

TOTAL: 45 PERIODS

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Text books

1. AmbekarA. G., Mechanism and Machine Theory‖ Prentice Hall of India, New Delhi, 2007.
2. Shigley J.E., Pennock G.R and Uicker J.J., —Theory of Machines and Mechanisms‖, Oxford University Press, 2003.

References

1. Ghosh.A, and A.K.Mallick, —Theory and Machine ‖, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
2. Ramamurthi. V., "Mechanisms of Machine", Narosa Publishing House, 2005.
3. Rao.J.S. and Dukkipatti R.V. —Mechanisms and Machines ‖, Wiley-Eastern Ltd., New Delhi, 1998.
4. Robert L.Norton, "Design of Machinery", McGraw-Hill, 2012.
5. Thomas Bevan, —Theory of Machines‖, CBS Publishers and Distributors, 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	3	2	2	2							2	1	3	2	
CO2	3	2	2	2					1		2	1	3	2	
CO3	3	2	2	2					1		2	1	3	2	
CO4	3	2	2	2					1		2	1	3	2	
CO5	3	2	2	2					1		2	1	3	2	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand and Analyze	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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AE405	Aerodynamics	L	T	P	C
		3	0	2	4
Nature of Course	Professional Core				
Pre requisites	Fluid Mechanics and Machinery				

Course Objectives
The course is intended to

1. Introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
2. Acquire knowledge about the concept of 2-D in viscid flows.
3. Learn the methodology of conformal transformation and theory of airfoils.
4. Know the concepts of subsonic wing theory.
5. Introduce the basics of viscous flow.

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

CO. No.	Course Outcome	Bloom's Level
CO1	Apply the fundamental concepts of mass, momentum, energy conservation equations for aerodynamic applications.	Apply
CO2	Study of two dimensional flows in aerodynamics (elementary flows) and their combinations.	Understand
CO3	Know about Joukowski transformation and its application to fluid flow Problems.	Understand
CO4	Analyze airfoil and wing theory.	Understand
CO5	Discuss the real time viscous flow and Boundary Layer behavior.	Understand

Course contents:

UNIT – I Fundamental Equation of Aerodynamics **9**
Euler equation, incompressible Bernoulli's equation - Continuity, momentum and energy equations, Circulation and Vortices, streamline, stream function, irrotational flow, potential function, equipotential lines.

UNIT – II Fundamental of Two Dimensional In viscid Incompressible Flow **9**
Elementary flows – uniform parallel flow, Source, Sink, Doublet, Vortex, Their combinations, Ideal flows over a circular cylinder. Kutta joukowski theorem. D' Alembert Paradox, Starting vortex, Magnus effects.

UNIT – III Conformal Transformation of Aero foil Theory **9**
Cauchy-riemann relations, complex potential, kutta joukowski transformation, Karman Trefftz Profiles, Thin airfoil theory and its applications.

UNIT – IV Theory of Finite Wings **9**
Vortex filament, biot-savart law, bound vortex, trailing vortex, horse shoe vortex, Lifting line theory and its limitations, lift and induced drag coefficients for elliptic lift distribution

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UNIT – V Boundary Layer Theory **9**

Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, energy thickness, boundary layer equations for a steady, two dimensional incompressible flow, boundary layer growth over a flat plate, critical Reynolds number, blasius solution.

TOTAL: 45 PERIODS

Laboratory Components

S. No.	Exercises	CO Mapping	Blooms Level
1	Calibration of a Subsonic Wind tunnel.	1,2	Apply
2	Determination of lift for the given airfoil section.	1,2	Apply
3	Pressure distribution over a smooth circular cylinder.	1,2	Apply
4	Pressure distribution over a rough circular cylinder.	1,2	Apply
5	Pressure distribution over a symmetric aero foil.	1,2	Apply
6	Pressure distribution over a cambered aero foil.	1,2	Apply
7	Force measurement using wind tunnel balancing set up.	1,2	Apply
8	Flow over a flat plate at different angles of incidence.	1,2	Apply
9	Flow visualization studies in low speed flows over cylinders.	1,2	Understand
10	Flow visualization studies in low speed flows over airfoil with different angle of incidence.	1,2	Understand

List of Equipment for a Batch of 30 Students

S.No	Name of the equipment	Quantity	Experiment No.
1.	Subsonic Wind tunnel	1	1,2,4,5,6,7,8,9,10
2.	Models(aerofoil, rough and smooth cylinder , flat plate)	2	5,6,7,8,9,10
3.	Angle of incidence changing mechanism	1	8,10
4.	Multi tube Manometer	1	2,3,4,5,6
5.	Pitot-Static Tubes	1	1
6.	Cylinder models (Rough and Smooth)	1	3,4
7.	Wind Tunnel balances (3 or 6 components)	1	7
8.	Smoke Generator	1	8,9,10
9.	Water flow channel	1	8,9,10

Text books

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., 2010
2. Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.

References

1. Ethirajan Rathakrishnan, "Theoretical Aerodynamics", 1st Edition, Wiley Publications, 2013.
2. L. J. Clancey, "Aerodynamics", Shroff Publications, 2006.
3. Katz and Plotkin, Low Speed Aerodynamics, Cambridge Univ. Press, 2002.

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Web References

4. http://nptel.ac.in/courses/112105171/1
5. http://nptel.ac.in/courses/112104118/
6. https://www.edx.org/course/introduction-to-aerodynamics

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	2	-	-	-	-	-	2	2	3	3	-
CO2	2	3	2	2	2	-	2	-	-	-	2	3	3	2	-
CO3	2	3	2	2	2	1	-	-	-	-	2	2	3	2	-
CO4	-	3	2	2	2	2	-	-	-	-	2	2	3	2	-
CO5	3	2	3	3	2	2	2	-	-	-	2	2	3	2	-
	3	High					Medium					2	Low		

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (50)**
	IAE I (7.5)	**IAE II (7.5)**	**IAE III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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

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20AE406	Propulsion Laboratory	L	T	P	C
		0	0	2	1
Nature of Course	Measurements of heat transfer components				
Pre requisites	Aircraft Propulsion				

Course Objectives

The course is intended to

1. Make the students to learn about the engine components
2. Introduce velocity profiles for free and wall jet experiments
3. Familiarize the students with cascade method of visualization
4. Learn the convention process through natural and forced methods

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Innovations about the piston engine and aircraft compressor	Understand
CO2	Investigation on combustion chamber and turbine of an aircraft engine	Understand
CO3	Experiment the free and wall jet velocity profiles	Evaluate
CO4	Test in the compressor blade as cascade	Evaluate
CO5	Render on convention through natural and forced methods	Evaluate

Laboratory Components

S. No	Exercises	CO Mapping	Blooms Level
1	Study of aircraft piston engine	1	Understand
2	Study of jet engine compressor	1	Understand
3	Study of jet engine combustion chamber	1	Understand
4	Study of jet engine turbine	1	Understand
5	Velocity profiles of free jets	2	Evaluate
6	Velocity profiles of wall jets	2	Evaluate
7	Cascade testing of compressor blades	2	Evaluate
8	Determination of heat transfer coefficient under natural convection	2	Evaluate
9	Determination of heat transfer coefficient under forced convection	2	Evaluate
10	Determination of Stefan – Boltzmann constant	2	Evaluate

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List of Equipment for a Batch of 30 Students

S. No	Name of the Equipment	Quantity	Experiment No.
1	Jet engine	1	2,3,4
2	Piston engine	1	1
3	Free jet apparatus	1	5,7
4	Wall jet apparatus	1	6,7
5	Natural Convection – vertical cylinder apparatus	1	8
6	Forced Convection inside tube apparatus	1	9
7	Stefan- Boltzmann apparatus	1	10

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	-	-	-	-	-	2	2	3	2	2
CO2	3	3	3	3	3	-	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	3	-	-	-	-	-	2	2	3	2	3
CO4	3	2	3	3	3	-	-	-	-	-	2	2	3	2	3
CO5	3	2	2	3	2	-	-	-	-	-	2	2	3	2	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			
Analyze			
Evaluate	60	60	60
Create			

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20AE407	Computer Aided Aircraft component Drawing	L	T	P	C
		0	0	2	1
Nature of Course	Professional Core				
Pre requisites	Engineering graphics				

Course Objectives

The course is intended to

1. Understand and interpret drawings of machine components
2. Prepare assembly drawings both manually and using standard CAD packages
3. Familiarize the students with Indian Standards on drawing practices and standard components
4. Gain practical experienceinhandling2Ddraftingand 3Dmodelingsoftwaresystems.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Explain the drawing standards, Fits and Tolerances	Understand
CO2	Apply the select, configure and synthesize components into 3D models	Apply
CO3	Ability to design and model difficult aeronautical component	Apply
CO4	Analyze draw, assemble and drafting aircraft components using CAD Package	Analyze
CO5	Create part drawings, sectional views and assembly drawings as per standards	Create

Laboratory Components

S. No	Exercises	CO Mapping	Blooms Level
1	Study of Drawing standards and fits and tolerances	1	Understand
2	Design and drafting of riveted joints	2	Apply
3	Design and drafting of welded joints	2	Apply
4	Design and modeling of rectangular plate with hole	2	Apply
5	Design and modeling of aerofoil sections	3	Apply
6	Design and modeling of cut section for wings	3	Apply
7	Design and modeling of bulk head	3	Apply
8	Modeling and drafting control components push-pull rod	4	Analyze
9	Modeling and drafting control components gear	4	Analyze
10	Design and drafting control components cam	4	Analyze
11	Modeling and Assembling of machine component	5	Create

List of Equipment for a Batch of 30 Students

Sl. No.	Name of the Equipment	Quantity
1	Computer	30
2	Modelling Packages	30 Licenses
3	Printer	1
4	UPS	1

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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	3	3	3	-	-	-	2	1	2	2	1	2	2
CO2	3	2	3	3	3	-	-	-	2	1	2	2	1	2	2
CO3	3	2	3	3	3	-	-	-	2	1	2	2	1	2	2
CO4	3	2	3	3	3	-	-	-	2	1	2	2	1	2	2
CO5	3	2	3	3	3	-	-	-	2	1	2	2	1	2	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	10	10	10
Apply	50	50	50
Analyze			
Evaluate	30	30	30
Create	10	10	10

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20MC401	Soft Skill (Common to All Branches of B.E., / B.Tech., Second Year)	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. 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	Make use of soft skills to gain self-confidence and high self-esteem.	Apply
CO4	Hone leadership skills and manage stress & conflict.	Apply
CO5	Systematize presentation effectively and participate in interview with confidence.	Apply

Course Contents

UNIT – I Introduction to soft skills and Interpersonal Communication **4**

An Introduction – Definition and Significance of Soft Skills; communication models, process and barriers; team communication; developing interpersonal relationships through effective communication and soft skills.

UNIT - II Public Speaking and Oral Communication skills **4**

Public Speaking: Skills, Methods, Strategies and Essential tips for effective public speaking. Group Discussion: Importance, Planning, Elements, Skills assessed - reverentially disagreeing, Initiating, Summarizing and Attaining the Objective.

UNIT – III Time Management and Personality Development **4**

Time Management – concept and essentials tips. Personality-development – meaning, nature, Features and Stages**,** gaining self-confidence and high self-esteem. - Business Etiquette

UNIT – IV Teamwork and Leadership skills **4**

Teamwork and Leadership Skills: Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills – Stress and conflict management, Developing Positive Thinking and Attitude.

UNIT-V Interview Skills **4**

Interviewer - Interviewee perspectives. Dos and Don'ts in an Interview process - Presentation Skills: Types, Content, Audience Analysis, and Essential Tips – before, during and after a presentation, Overcoming Nervousness.

Total: 20 Periods

Text Books

1. English and Soft Skills–S.P. Dhanavel, Orient Black swan India, 2010.

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2. Managing Soft Skills for Personality Development–edited by B.N.Ghosh, McGraw Hill, India, 2012.

Reference Books:

1. Soft Skills For A Big Impact: Banish Self-Doubt, Improve Workplace Ethics, Communication and Relationships, Resolve Conflicts, Achieve Breakthrough Success (hand books on soft skills Book 1) Kindle Edition by RENU SHOREY (Author)
2. Bridging the Soft Skills Gap: How to Teach the Missing Basics to Today's Young Talent Kindle Edition by Bruce Tulgan (Author)

Web reference:

1. 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		

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V SEMESTER

20AE501	Flight Dynamics	L	T	P	C
		3	2	0	4
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Aeronautics				

Course Objectives

The course is intended to

1. To study the performance of airplanes under various operating conditions
2. The static and dynamic response of aircraft for both voluntary and involuntary changes in flight conditions

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Know about the forces and moments that are acting on an aircraft, the different types of drag, drag polar, ISA, variation of thrust, power, SFC with velocity and altitude.	Apply
CO 2	Have understanding about performance in level flight, minimum drag and power required, climbing, gliding and turning flight, v-n diagram and load factor	Apply
CO 3	Knowledge about degrees of stability, stick fixed and stick free stability, stability criteria, effect of fuselage and CG location, stick forces, aerodynamic balancing.	Apply
CO 4	Understanding about lateral control, rolling and yawing moments, static directional stability, rudder and aileron control requirements and rudder lock.	Apply
CO 5	Understanding about dynamic longitudinal stability, stability derivatives, modes and stability criterion, lateral and directional dynamic stability.	Apply

Course Contents

Unit –I Cruising Flight Performance **9+3**

Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag –estimation of parasite drag co-efficient by proper area method- Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudes for air breathing engines . Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight - Conditions for minimum drag and power required

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Unit –II Manoeuvering Flight Performance **9+3**

Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide) – Takeoff and landing - Turning performance (Turning rate turn radius). Bank angle and load factor – limitations on turn - V-n diagram and load factor.

Unit –III Static Longitudinal Stability **9+3**

Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes -Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick force per 'g' - Aerodynamic balancing.

Unit –IV Lateral and Directional Stability **9+3**

Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.

Unit –V Dynamic Stability **9+3**

Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick - Brief description of lateral and directional. dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.

Total : 60 Periods

Text Books

1. Nelson, R.C. “Flight Stability and Automatic Control”, McGraw-Hill Book Co., 2004.
2. Perkins, C.D., and Hage, R.E., “Airplane Performance stability and Control”, John Wiley & Son:,Inc, NY, 1988.
3. McCornick. W., “Aerodynamics, Aeronautics and Flight Mechanics”, John Wiley, NY, 1979.

Reference Books

1. McCornick B. W, “Aerodynamics, Aeronautics and Flight Mechanics”, John Wiley, NY, 1995.
2. Etkin, B., “Dynamics of Flight Stability and Control”, Edn. 2, John Wiley, NY, 1982.
3. Dommasch, D.O., Sherby, S.S., and Connolly, T.F., “Aeroplane Aero dynamics”, Third Edition, Issac Pitman, London, 1981.
4. Babister, A.W., “Aircraft Dynamic Stability and Response”, Pergamon Press, Oxford, 1980.

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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	3	-	3	-	-	3	-	-	-	3	3	2
CO 2	2	3	3	3	-	3	-	-	3	-	-	-	3	3	3
CO 3	3	3	2	3	-	3	-	-	3	-	-	-	2	3	2
CO 4	2	3	3	3	-	3	-	-	3	-	-	-	3	2	2
CO 5	3	3	3	3	-	3	-	-	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 (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	40	40	40	80
Apply				
Analyze				
Evaluate				
Create				

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20AE502	Rocket and Space Propulsion	L	T	P	C
		3	2	0	4
Nature of Course	Professional Core				
Pre requisites	Aero Engineering Thermodynamics				

Course Objectives

The course is intended to

1. Familiarize about the ramjet and scramjet engines
2. Acquire the knowledge about chemical rocket propulsion
3. Learn about the principles of solid propellant rockets
4. To understand about liquid and hybrid rocket propulsion systems
5. Introduction about space propulsion and its applications

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understanding ramjet and hypersonic air breathing propulsion systems	Understand
CO2	Getting familiarity in chemical rocket propulsion systems	Apply
CO3	Detailing about solid propulsion systems	Apply
CO4	Interpreting the applications and principles of liquid propulsion systems	Apply
CO5	Gaining knowledge about the advanced propulsion techniques used for interplanetary space mission	Understand

Course Contents:

UNIT I Ramjet and Scramjet Propulsion **12**

Operating principle of Ramjet engine – combustion in Ramjet engine- ramjet performance and sample ramjet design calculations - Introduction to hypersonic air breathing propulsion - need for supersonic combustion for hypersonic propulsion – scramjet engine and its applications for hypersonic vehicles – problems associated with supersonic combustion – Components of hypersonic vehicles – various types of scramjet combustors and its fuel injection schemes

UNIT II Chemical Rocket Propulsion **12**

Operating principle – specific impulse and internal ballistics – performance characteristics of rockets – simple rocket design problems – types of igniters- Rocket nozzle classification - air augmented rockets – pulse rocket motors – static testing of rockets & instrumentation – safety considerations

UNIT III Solid Rocket Propulsion **12**

Salient features and selection criteria – estimation of solid propellant adiabatic flame temperature - propellant grain design considerations – erosive burning – combustion instability – strand burner and T-burner – applications and advantages

UNIT IV Liquid and Hybrid Rocket Propulsion **12**

Salient features and selection criteria – applications and limitations - various feed systems - thrust control and cooling methods – combustion instability – operation of cryogenic engines - hybrid rocket propulsion – standard and reverse hybrid systems

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UNIT V Space Propulsion **12**

Electric rocket propulsion – future applications of electric propulsion - Ion propulsion – Nuclear rocket – preliminary concepts in nozzle-less propulsion – Solar sail - comparison of performance of these propulsion systems with chemical rocket propulsion systems – current scenario of advanced propulsion projects worldwide

Total: 60 Periods

Text Books:

1. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 2014.
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 8th Edition, 2010.

Reference Book:

1. Robert G. Jahn, "Physics of Electric Propulsion", Dover Publications, 2006.

Additional References:

1. https://nptel.ac.in/courses/101/106/101106082/
2. https://www.grc.nasa.gov/www/k-12/rocket/rocket.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	3	2	1	2	1	-	2	-	-	-	3	2	3
CO2	3	3	3	2	1	2	1	-	2	-	-	-	3	2	3
CO3	3	3	3	2	1	2	1	-	2	-	-	-	3	2	3
CO4	3	3	3	2	1	2	1	-	2	-	-	-	3	2	3
CO5	3	3	3	2	1	2	1	-	2	-	-	-	3	2	3
	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				

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20AE503	Compressible Flow Aerodynamics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Low Speed Aerodynamics				

Course Objectives

The course is intended to

1. To introduce the concepts of compressibility and flow through convergent- divergent nozzle,
2. To make the student understand the theory behind the formation of shocks and expansionfans in Supersonic flows.
3. To make the student recognize the shock wave problems in supersonic flows.
4. To understand the Linearized flow theory for streamlined bodies.
5. To study the fundamental of compressible flow equations and transonic flow over wing

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 continuum, compressibility, and calculate the compressible flow through a duct of varying cross section.	Apply
CO2	To understand about the formation of normal and oblique shocks	Understand
CO3	Solve numerical problemsrelated to shock wavein supersonic flow and design concept of supersonic nozzle.	Apply
CO4	Apply the Linearized flow theory for streamlined bodies	Apply
CO5	Apply the concepts to increase the performance of an aircraft during transonic and supersonicspeeds	Apply

Course contents:

UNIT I One Dimensional Compressible Flow **10**

Continuity, Momentum, Energy and state equations, adiabatic steady state flow equations, velocity of sound, Flow through convergent- divergent passage, Performance under various back pressures.

UNIT II Normal and Oblique Shocks **12**

Prandtl equation and Rankine – Hugonoit relation, Normal shock equations, Pitot static tube,corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations,Hodograph and pressure turning angle, shock polar, flow past wedges and concave corners,strong, weak and detached shocks

UNIT III Expansion Waves and Method of Characteristics **8**

Flow past convex corners, Expansion hodograph, Reflection and interaction of shocks andexpansion, waves. Method of Characteristics Two dimensional supersonic nozzle contours.Rayleigh and Fanno Flows.

UNIT IV Differential Equations of Motion for Steady Compressible Flows **7**

Small perturbation potential theory, Prandtl-Glauert rule - affine transformation relations for subsonic flows, Linearized two dimensional supersonic flow theory - Lift, drag, pitching moment and center of pressure of supersonic profiles.

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UNIT V High Speed Flow Over Wing **8**

Lower and upper critical Mach numbers, Lift and drag, divergence, Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, transonic area rule. Introduction to Hypersonic Aerodynamics.

Total: 45 Periods

(Use of Standard and approved Gas Tablesare permitted)

Text books:

1. Anderson Jr., D., – "Modern compressible flows", McGraw-Hill Book Co., New York, 1999.
2. L.J. Clancy, "Aerodynamics" Sterling Book House, 2006
3. Rathakrishnan, E., "Gas Dynamics", 6th Edition, Prentice Hall of India, 2017.

References:

1. Shapiro, A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press,1982
2. Zucrow, M.J. and Anderson, J.D., "Elements of gas dynamics", McGraw-Hill Book Co. New York, 1989.
3. J. D. Anderson, "Fundamentals of Aerodynamics", Fifth Edition, McGraw Hill Education IndiaPrivate Limited, 2010.

Additional references:

1. http://nptel.ac.in/courses/112103021/
2. http://nptel.ac.in/courses/101106044/
3. https://nptel.ac.in/courses/101/105/101105059/

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	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
	3	High				2	Medium					1	Low		

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AE504	Aircraft Structural Analysis	L	T	P	C
		3	0	2	4
Nature of Course	Professional Core				
Pre requisites	Strength of Materials for Aeronautical Engineers,Aircraft Structural Mechanics				

Course Objectives

The course is intended to

1. Calculate the Bending Stress for Unsymmetrical and Symmetrical section
2. Provide the knowledge of shear flow calculation and shear centerestimation for closed and open sections
3. Understand the buckling of plates and using the concepts to solve the sheet panel problems
4. Provide the practical exposure to estimate allowable stresses due to stresses Calculated. To check the strength of the component and to estimate Margins of Safety
5. Prepare students for designing structural elements of the wing and fuselage sections

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Analyze the stresses with different axis like Principal plane, NA plane and two mutually perpendicular axis	Analyze
CO2	Sketch the Shear Flow Distribution in open and Closed Section	Understand
CO3	Analyze the failure modes occur in thin walled plates structures	Analyze
CO4	Learn the types of calculating the allowable stresses for varying sections using different methods	Apply
CO5	Construct the Aircraft skin with stiffener and their location.	Apply

Course contents:

UNIT – I Unsymmetrical Bending **9**

Bending stresses in beams of unsymmetricalsections– Generalized k-method, Neutral axis method, Principal axis method

UNIT – II Shear Flow in open Sections **9**

Thin-walled beams – Concept of shear flow – The shear center and its determination – Shear flow distribution in symmetrical and unsymmetrical thin-Walled sections

UNIT – III Shear Flow In Closed Sections **9**

Bredt - Batho theory – Single-cell and multi-cell tubes subject to torsion – Shear flow distribution in thinwalled single & Multi-cell structures subject to combined bending and torsion – With walls effective and ineffective in bending

UNIT – IV BUCKLING OF PLATES **9**

Rectangular sheets under compression – Local buckling stress of thin walled sections – Crippling stresses by Needham's and Gerard's methods– Sheet stiffener panels – Effective width – Inter rivet and sheet wrinkling failures.

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UNIT – V Stress Analysis in Wing And Fuselage **9**

Loads on an aircraft – the V-n diagram – shear force and bending moment distribution over the aircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel flanges – complete tension field beams – semi-tension field beam theory

Total: 45 Periods

Laboratory Components

S. No.	Exercises	CO Mapping	Blooms Level
1	Unsymmetrical bending of beams	1	Apply
2	Shear center location for open sections	1,2	Apply
3	Shear center location for closed sections.	1,2	Apply
4	Shear center location for Angle sections	1,2	Apply
5	Wagner beam - Tension field beam	5	Apply
6	Combined bending and Torsion of a Hollow Circular Tube	5	Apply
7	Flexibility matrix of a cantilever beam	1,2,3	Apply
8.	Fabrication of composite laminate	3,4	Apply
9.	Stresses in circular disc using photo elastic model	4	Apply
10.	Stresses in circular disc using photo elastic model	4	Apply

Total: 30 Periods

List of Equipment for a Batch of 30 Students

S. No.	Name of the equipment	Quantity	Experiment No.
1.	Wagner beam	1	5
2.	Unsymmetrical bending set up	1	1
3.	Set up for combined bending and torsion	1	6
4.	Photo elasticity set up	1	9,10
5.	Beams with weight hangers and dial gauges	3	2,3,4,7

Text books

1. T. M. G. Megson, "Aircraft Structures for Engineering Students", Butterworth Heinemann, 2012
2. Bruhn. E.H., "Analysis and Design of Flight Vehicles Structures", Tri-state off-set Company, USA, 1985
3. Bruce K. Donaldson., 'Analysis of Aircraft Structures', Second Edition, Cambridge University Press., 2008

References

1. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999
2. Howard D Curtis, "Fundamentals of Aircraft Structural Analysis", WCB-McGraw Hill, 1997
3. G. Lakshmi Narasaiah, 'Aircraft Structures', CRC Press, 2011.
4. C T Sun, 'Mechanics of Aircraft Structures', Second Edition, Wiley publisher, April 2006.

Web References

1. https://ocw.mit.edu/courses/mechanical-engineering/2-080j-structural-mechanics-fall-2013/course-notes/MIT2_080JF13_Lecture11.pdf
2. https://www.youtube.com/watch?v=jwTrStB_8Lg
3. https://www.youtube.com/watch?v=WCEsOI9m97o&t=542s

CHAIRMAN - BOARD OF STUDIES

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	-	-
CO2	3	2	2	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	3	-	2	-	-	-	-	-	-	-	3	-	-
CO5	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	

Theory with Practical

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

CHAIRMAN - BOARD OF STUDIES

20AE505	Aero engine & Airframe Laboratory	L	T	P	C
		0	0	2	1
Nature of Course	Professional Core				
Pre requisites	Aeronautical Engineering Practices Laboratory				

Course Objectives

The course is intended

1. To introduce the knowledge of the maintenance and repair procedures of aero engines.
2. To enrich the knowledge for overhaul of aero engines.
3. To practice the composite structure fabrication.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Ability to maintain and repair the aero engines.	Apply
CO 2	Ability to overhaul auxiliary systems, pumps, carburetorlubrication and cooling system	Apply
CO 3	Ability to practice wood gluing and welding	Apply
CO 4	To practice the Rivet, Tube bending and flaring	Apply
CO 5	Preparation of sheet metal work and composite laminate structures	Apply

Laboratory Components

S. No.	Exercises	CO Mapping	Blooms Level
1.	Dismantling and reassembling of an aircraft piston engine.	CO1	Understand
2.	Study of Camshaft operation, firing order and magneto, valve timing	CO1	Understand
3.	Study of lubrication and cooling system	CO1	Understand
4.	Study of auxiliary systems, pumps and carburetor	CO1	Understand
5.	Aircraft wood gluing-single & double scarf joints	CO2	Analyze
6.	Welded single & double V-joints.	CO3	Analyze
7.	Fabric & Riveted Patch repairs	CO4	Analyze
8.	Tube bending and flaring	CO4	Analyze
9.	Sheet metal forming	CO5	Analyze
10.	Preparation of glass epoxy of composite laminates and specimens.	CO3	Analyze

CHAIRMAN - BOARD OF STUDIES

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of the equipment	Quantity	Experiment No.
1.	Aircraft Piston engines	1	1,2
2.	Set of basic tools for dismantling and assembly	1 set	1,2
3.	NDT equipment	1 set	6,7
4.	Micrometers, depth gauges, vernier calipers	2 sets	1 to 10
5.	Valve timing disc	1	2
6.	Shear cutter pedestal type	1	9
7.	Drilling Machine	1	7
8.	Bench Vices	1	5
9.	Radius Bend bars	1	8
10.	Pipe Flaring Tools	1	8
11.	Welding machine	1	6
12.	Glass fibre, epoxy resin	1	10
13.	Strain gauges and strain indicator	1	1 to 10

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	-	-	-	-	2	-	-	-	2	-	-
CO2	3	3	3	3	-	-	-	-	2	-	-	-	2	-	-
CO3	3	3	3	3	-	-	-	-	2	-	-	-	2	-	-
CO4	3	3	2	3	-	-	-	-	2	-	-	-	2	-	-
CO5	3	3	2	3	-	-	-	-	2	-	-	-	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			
Analyze			
Evaluate	60	60	60
Create			

CHAIRMAN - BOARD OF STUDIES

VI SEMESTER

20AE601	FINITE ELEMENT METHODS	L	T	P	C
		3	2	0	4
Nature of Course	Professional Core				
Pre requisites	Strength of Materials and Mathematics				

Course Objectives

The course is intended to

1. Introduce the concepts of Mathematical Modeling of Engineering Problems
2. Study 1D structural and thermal problems with FE technique
3. Practice 2D finite element problems.
4. Recognize the concepts of axisymmetric and apply to real time problems
5. Appreciate the use of FEM to a range of Engineering Problems

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Apply direct stiffness, Rayleigh -Ritz, Galerkin method to solve engineering problems.	Understand
CO2	Solve linear 1D structural rod, beams and frames problems.	Apply
CO3	Solve two dimensional Structural problems FEM method.	Apply
CO4	Derive shape functions for 4 and 8 node quadrilateral and apply numerical integration.	Apply
CO5	Calculate heat conduction and convection heat transfer problems and familiarize FEA software.	Analyze

Course Contents:

UNIT I Introduction **9**

Review of various approximate methods – variational approach and weighted residual approach - application to structural mechanics problems. finite difference methods- governing equation of finite element method.

UNITII Discrete Elements **9**

Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element. Beam element - problems for various loadings and boundary conditions – 2D and 3D Frame elements.

UNIT III Continuum Elements **9**

Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric element.

UNIT IV Isoparametric Elements **9**

Definitions, Shape function for 4 and 8 nodal quadrilateral elements, stiffness matrix and consistent load vector, evaluation of element matrices using numerical integration.

UNIT V Field Problem And Methods Of Solutions **9**

Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems – Features of software packages, sources of error.

Total: 45 Periods

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Text Books:

1. Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

Reference Books:

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013).
2. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice Hall College Div, 1990.
3. Logan, D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002.
4. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butterworth Heinemann, 2004.
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 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	-	-	-	-	-	1	2	3	-	1
CO2	2	3	2	2	2	-	-	-	-	-	1	2	3	2	2
CO3	3	3	2	2	2	-	-	-	-	-	1	2	2	2	3
CO4	2	2	2	2	2	-	-	-	-	-	-	2	2	2	1
CO5	3	2	3	2	2	-	-	-	-	-	1	2	2	2	1
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’sLevel	**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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20AE602	Composite Materials andStructures	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Engineering Materials and Metallurgy				

Course Objectives:

The course is intended to

1. To make the student understand the analysis of composite laminates under different loading conditions and different environmental conditions.
2. To learn the manufacturing of composite materials.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understanding the mechanics of composite materials	Understand
CO2	Ability to analyse the laminated composites for various loading eases	Analyse
CO3	Knowledge gained in manufacture of composites.	Understand
CO4	Should analyze sandwich and laminated plates	Analyse
CO5	Should be able to construct and analysis different composite technique	Analyse

Course Contents

Unit –I Micromechanics **9**

Introduction - advantages and application of composite materials – types of reinforcements and matrices - micro mechanics – mechanics of materials approach, elasticity approach- bounding techniques – fiber volume ratio – mass fraction – density of composites. effect of voids in composites.

Unit –II Macromechanics **9**

Generalized Hooke's Law - elastic constants for anisotropic, orthotropic and isotropic materials - macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis – determination of in plane strengths of a lamina - experimental characterization of lamina. failure theories of a lamina. hygrothermal effects on lamina.

Unit –III Laminated Plate Theory **9**

Governing differential equation for a laminate. stress – strain relations for a laminate. different types of laminates. in plane and flexural constants of a laminate. hygrothermal stresses and strains in a laminate. failure analysis of a laminate. impact resistance and interlaminar stresses. netting analysis

Unit –IV Fabrication Process and Repair Methods **9**

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Various open and closed mould processes, manufacture of fibers, importance of repair and different types of repair techniques in composites – autoclave and non-autoclave methods.

Unit –V Sandwich Constructions **9**

Basic design concepts of sandwich construction - materials used for sandwich construction - failure modes of sandwich panels - bending stress and shear flow in composite beams

Total : 45 Periods

Text Books

1. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 2nd edition, 2005.
2. Isaac M. Daniel &Orilshai , "Mechanics of Composite Materials," OUP USA publishers, 2 ndedition, 2005.
3. MadhujitMukhopadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

Reference Books

1. Michael F. Ashley, "Material Selection in Mechanical Design", 5th edition, Butterworth-Heiner, 2016
2. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley & Sons, 3rd edition, July 2006.
3. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, 2ndEdition, 2004
4. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Nostrand Reinhold Company, New York 1998.
5. Lubing, Handbook on Advanced Plastics and Fibre Glass, Von Nostran Reinhold Co., New York, 1989.

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	-	3	-	3	-	-	3	-	-	2	2	3
CO2	3	3	2	-	3	-	3	-	-	3	-	-	2	3	3
CO3	3	3	3	-	3	-	3	-	-	3	-	-	2	3	2
CO4	3	3	3	-	3	-	3	-	-	3	-	-	2	2	2
CO5	2	3	3	-	3	-	3	-	-	2	-	-	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	

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AE603	Professional Ethics in Engineering	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	NIL				

Course Objectives:

The course is intended to

1. To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Knowledge of Professional ethics	Understand
CO2	Ability to apply ethics in society.	Understand
CO3	Ability to discuss the ethical issue related to engineering.	Understand
CO4	Ability to realize the responsibilities.	Understand
CO5	Have knowledge on rights in the society.	Understand

Course Contents:

UNIT I Human Values **9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation - Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II Engineering Ethics **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III Engineering as Social Experimentation **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV Safety, Responsibilities and Rights **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V Global Issues **9**

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Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

Total: 45 Periods

Text books:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
2. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

References:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
4. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011.

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	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO5	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	

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AE604	UAV Systems	L	T	P	C
		3	0	2	4
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Aeronautics and Flight Mechanics				

Course Objectives

The course is intended to

1. To know about the basic terminology and design stages of UAV and MAV.
2. To understand the aerodynamics, airframe configurations and structures.
3. To impart knowledge about the avionics system used in UAV and MAV
4. To understand the communication and control systems for suitable payloads.
5. To expose the navigation system and future challenges in mini-UAV.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Explain the basic terminologies to develop the UAV systems.	Understanding
CO2	Prepare preliminary design requirements for an unmanned aerial vehicle.	Analyze
CO3	Ability to identify different hardware for UAV	Understanding
CO4	Perform system testing for unmanned aerial vehicles.	Analyze
CO5	Design micro aerial vehicle systems by considering practical limitations.	Understanding

Course contents:

UNITI Introduction to UAV **9**

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications

UNITII The Design of UAV Systems **9**

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations-Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA and Europe-Design for Stealth--control surfaces-specifications.

UNITIII Avionics Hardware **9**

Autopilot – AGL- Selection of motors and Battery-UAV and MAV airframe weight calculations, pressure sensors-servos-accelerometer –gyros-actuators- power supply processor, installation and testing.

UNITIV Communication PayloadsandControls **9**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range – modems-memory system-simulation-ground test-analysis-trouble shooting

UNITV The Development OfUAV Systems **9**

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing-Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

Total: 45 Periods

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Laboratory Components

S. No.	Exercises	CO Mapping	Blooms Level
1	Fabricate thebasic glider models.	1	Apply
2	Components and material selection for UAV's.	2,3	Apply
3	Determine the Centre of gravity calculation of Fixed wing UAV.	2	Apply
4	Determine the payload and weight estimation of UAV	4	Apply
5	Calibration of motors thrust with various ESC & propellers.	3,4	Apply
6	Design of fuselage for a Fixed wing UAV.	2	Apply
7	Design of wings and tail for a fixed wing UAV.	3	Apply
8	Fabrication of Fixed Wing UAV	1,2,3,4	Apply
9	Drone base and avionic components assembling in Quadcopter configuration.	4,5	Apply
10	Conduct the RC transmitter resetting, calibration & frequency binding.	5	Apply
11	Propeller balancing procedure.	2	Apply
12	Testing of lithium battery and maintenance.	4	Apply
13	Study the troubleshooting of UAV systems.	4,5	Apply

Total: 30periods

Text books:

1. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc, 1998.
2. Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.

References:

1. Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company,2001
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc,1998.
3. MirosawAdamski, "Power units and power supply systems in UAV", New Edition, Taylor and Francis Group publishers, 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	3
CO1	3	2	3	2	2	-	-	-	-	-	-	2	2	2	-
CO2	3	2	3	2	2	-	-	-	-	-	-	2	3	2	-
CO3	3	2	3	-	2	-	-	-	-	-	-	3	2	2	-
CO4	3	3	2	-	2	-	-	-	-	-	-	2	2	2	-
CO5	3	2	3	2	2	-	-	-	-	-	-	2	2	2	-
	3	**High**				**2**	**Medium**					**1**	**Low**		

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

Theory with Practical

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

CHAIRMAN - BOARD OF STUDIES

20AE605	Analysis and Simulation Laboratory	L	T	P	C
		0	0	2	1
Nature of Course	Professional Core				
Pre requisites	Finite Element Methods				

Course Objectives

The course is intended to

1. To make the students familiarize with computational fluid dynamics and structural analysis software tools.
2. By employing these tools for Aerospace applications students will have an opportunity to expose themselves to simulation software.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Simulate flow inside the nozzle and compressor using ANSYS Fluent.	Analyze
CO 2	Simulate flow over subsonic and supersonic wing and diffusers ANSYS Fluent.	Analyze
CO 3	Simulation flow through turbine blade passage ANSYS Fluent.	Analyze
CO 4	Analysis stress and deflection of wing , fuselage and landing gear structure using Fem Software	Analyze
CO 5	Analysis Composite structure using Fem Software	Analyze

Laboratory Components

S. No.	Exercises	CO Mapping	Blooms Level
1	Grid independence study and convergence test using any simple case like pipe flow, diffuser flow, flow over a cylinder, aero foil etc.	CO1	Apply
2	Simulation of flow over backward facing step.	CO1	Apply
3	Simulation of Karman vortex trail (vortex shedding) using circular cylinder.	CO2	Apply
4	External flow simulation of subsonic and supersonic aero foils.	CO2	Apply
5	Internal flow simulation of subsonic, sonic and supersonic flow through a CD nozzle.	CO3	Analyze
6	Structural analysis of bar, beam and truss.	CO3	Analyze
7	Structural analysis of tapered wing.	CO4	Analyze
8	Structural analysis of fuselage structure.	CO4	Analyze
9	Analysis of composite laminate structures.	CO5	Analyze
10	Heat transfer analysis of structures.	CO5	Analyze

CHAIRMAN - BOARD OF STUDIES

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of the equipment	Quantity	Experiment No.
1	Internal server (or) Work station	1	All
2	Computers	30	All
3	Standard Modelling and analysis packages	30 licenses	All
4	UPS	1	All
5	Printer	1	All

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	-	-	-	-	-	2	2	3	-	1
CO2	3	3	3	3	3	-	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	3	-	-	-	-	-	2	2	3	2	3
CO4	3	3	3	3	3	-	-	-	-	-	2	2	3	2	3
CO5	3	3	3	3	3	-	-	-	-	-	2	2	3	3	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			
Apply	40	40	40
Analyze	60	60	60
Evaluate			
Create			

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VII SEMESTER

20AE701	Computational Fluid Dynamics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fluid dynamics, Heat transfer				

Course Objectives

The course is intended to

1. Familiarize Governing Equations of viscous fluid flows
2. Introduce numerical modeling and its role in the field of fluid flow and heat transfer.
3. Create confidence to solve complex
4. Enable the students to understand the various discretization methods, solution procedures and turbulence modeling

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Derive the governing equations and boundary conditions for Fluid dynamics	Understand
CO2	Analyze Finite difference and Finite volume method for Diffusion	Apply
CO3	Analyze Finite volume method for Convective diffusion	Apply
CO4	Analyze Flow field problems	Apply
CO5	Explain the Turbulence models and Mesh generation techniques	Understand

Course Contents:

UNIT I Governing Equations and Boundary Conditions 9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II Finite Difference and Finite Volume Methods for Diffusion 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Use of Finite Difference and Finite Volume methods.

UNIT III Finite Volume Method for Convection Diffusion 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

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UNIT IV Flow Field Analysis **9**

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V Turbulence Models and Mesh Generation **9**

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

Total: 45 Periods

Text Books:

3. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd, Second Edition, 2007.
4. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 2017.

Reference Books:

1. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2014.
5. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004

Additional References:

3. https://nptel.ac.in/courses/112/105/112105045/
4. https://nptel.ac.in/courses/112/107/112107080/

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	2	3	3	2	-	-	-	-	-	2	1	2	-	-
CO2	3	3	2	3	3	-	-	-	-	-	2	1	2	-	-
CO3	3	3	3	3	2	-	-	-	-	-	2	1	2	-	-
CO4	3	2	2	2	2	-	-	-	-	-	2	1	2	-	-
CO5	2	2	2	2	2	-	-	-	-	-	2	1	2	-	-
	3	High				2	Medium					1	Low		

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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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

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20AE702	Innovation & Entrepreneurship	L	T	P	C
		3	0	0	3
Nature of Course	Employability Enhancement Courses				
Pre requisites					

Course Objectives

The course is intended to

1. To promote the innovation & entrepreneurship skills of the students

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Comprehend the role of bounded rationality, framing, causation and effectuation inentrepreneurial decision making.	Understand
CO2	Demonstrate an ability to design a business model canvas.	Apply
CO3	Evaluate the various sources of raising finance for startup ventures.	Apply
CO4	Understand the fundamentals of developing and presenting business pitching topotential investors.	Apply
CO5	Forms of business organizations	Understand

Course Contents:

Unit I Introduction to Entrepreneurship **9**

Entrepreneurs; entrepreneurial personality and intentions- characteristics, traits and behavioral, entrepreneurial challenges.

Unit II Entrepreneurial Opportunities **9**

Opportunities. Discovery / creation, Pattern identification andrecognition for venture creation: prototype and exemplar model, reverse engineering.

Unit III Entrepreneurial Process and Decision Making **9**

Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches**,** Effectuation and Causation.

Unit IV Crafting business models and Lean Start-ups **9**

Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

Unit V Organizing Business and Entrepreneurial Finance **9**

Forms of business organizations; organizational structures; Evolution of Organisation, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

Total: 45 Periods

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Text Books:

1. Ries, Eric (2011), The lean Start-up: How constant innovation creates radically successful businesses, Penguin Books Limited.
2. Blank, Steve (2013), The Startup Owner's Manual: The Step by Step Guide for Building a Great Company, K&S Ranch.

Reference Books:

1. T. H. Byers, R. C. Dorf, A. Nelson, Technology Ventures: From Idea to Enterprise, McGraw Hill (2013)
2. Osterwalder, Alex and Pigneur, Yves (2010) Business Model Generation.
3. Kachru, Upendra, India Land of a Billion Entrepreneurs, Pearson
4. Bagchi, Subroto, (2012). MBA At 16: a Teenager's Guide to Business, Penguin Books
5. Bansal, Rashmi, Stay Hungry Stay Foolish, CIIE, IIM Ahmedabad
6. Bansal, Rashmi, (2013). Follow Every Rainbow, Westland.
7. Verstraete, T. and Laffitte, E.J. (2011). a Business Model of Entrepreneurship, Edward Elgar Publishing.

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
CO2	3	-	-	-	-	-	-	2	-	-	-	3	-	-	3
CO3	3	-	-	-	-	-	-	2	-	-	-	3	-	-	3
CO4	3	-	-	-	-	-	-	2	-	-	-	3	-	-	3
CO5	3	-	-	-	-	-	-	2	-	-	-	3	-	-	3
	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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

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20AE703	Aircraft Design	L	T	P	C
		3	0	0	3
Nature of Course	Professional core				
Pre requisites	Flight dynamics, aircraft structures				

Course objectives:

The course is intended to

1. To introduce and develop basic concept of aircraft design
2. At the end of this course, the student should be able to understand and apply the various concepts related to airplane design.
3. The student should be able to design various structural components of the aircraft.
4. The student should be able to estimate the weight, performance and stability parameters of various types of aircrafts during various flight conditions.
5. The course enables students to conceptually design various types of aircrafts.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Analyze various concepts related to aircraft design	Analyze
CO 2	Estimate weight & geometrical parameters of different types of aircrafts	Analyze
CO 3	Learn basic aspects of Propulsion system and design of an various types of aircrafts flying under various flight conditions.	Understand
CO 4	Analyze and estimate performance parameters during aircraft design	Analyze
CO 5	Estimate and analyze the landing and take-off performance	Apply

Course Contents

Unit I Introduction **6**

State of art in airplane design, Purpose and scope of airplane design, Classification of airplanes based on purpose and configuration. Factors affecting configuration, Merits of different plane layouts. Stages in Airplane design. Aircraft design, Requirements and specifications, Features of special purpose airplanes, unmanned aerial vehicles and their features, Control configured vehicles.

Unit II Preliminary Design Procedure **9**

Data collection and 3-view drawings, · their purpose, weight estimation, Weight equation method – Development & procedures for evaluation of component weights. Weight fractions for various segments of mission. Choice of wind loading and thrust loading.

UNIT III Power Plant Selection and Design of Wing **10**

Choices available, comparative merits, Location of power plants, Functions dictating the locations. Selection of aerofoil. Selection of Wing parameters, selection of sweep, Effect of Aspect ratio, Wing Design and Airworthiness requirements, V-n diagram, loads, Structural features.

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UNIT IV Fuselage and Empennage **10**

Elements of fuselage design, Loads on fuselage, Fuselage Design. Fuselage and tail sizing. Determination of tail surface areas, Tail design, Structural features, check for nose wheel lift off.

UNIT V Design of Landing Gear and Control Surface **10**

Landing Gear Design, Loads on landing gear, Preliminary landing gear design. Requirement of undercarriage, Different arrangements, Mechanism for retraction into fuselage and wing, Absorption of landing loads, Calculations of loads

Total: 45 Periods

Text books:

1. Raymer, D.P. Aircraft conceptual Design, AIAA series, 5th edition, 2012.
2. Torenbeck, E. Synthesis of Subsonic Airplane Design, Delft University Press, U.K. 2013.
3. John P. Fielding, Introduction to Aircraft Design, second edition,2017

Reference:

1. Kuechemann, D, " The Aerodynamic Design of Aircraft, American Institute of Aeronautics publishers, 2012
2. Aircraft Performance and Design: J. D. Anderson Jr., TATA McGRAW-HILL, 2010.

Web references:

1. https://nptel.ac.in/courses/101/106/101106035/

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	-	1	1	-	2	-	-	-	-	-	2	2	1	-
CO2	3	-	1	1	-	2	-	-	-	-	-	2	2	1	-
CO3	3	-	1	1	-	2	-	-	-	-	-	2	2	1	-
CO4	2	-	1	1	-	2	-	-	-	-	-	1	2	1	-
CO5	1	-	1	1	-	2	-	-	-	-	-	1	1	1	-
	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	

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination**
	IAE- I	**IAE - II**	**IAE - III**	
	(7.5)	**(7.5)**	**(10)**	**(60)**
Remember	10	10	10	20
Understand	30	30	30	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

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20AE704	Aircraft Systems & Flight Simulator Laboratory	L	T	P	C
		0	0	2	1
Nature of Course	Aircraft Systems, Flight Simulator				
Pre requisites	Aircraft General Engineering and Maintenance Practices, Flight Stability and Control				

Course Objectives

The course is intended

1. To study the procedure involved in maintenance of Aircraft Systems.
2. To study the maintenance of filter, hydraulic and fuel systems.
3. To study the performance of brake components.
4. To study the flight simulator.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Ability to understand to procedure involved in maintenance of various air frame systems	Analyze
CO 2	Explain the four fundamental forces of the flight.	Analyze
CO 3	Describe integrated flight instruction.	Analyze
CO 4	Perform the Steep turns and ground reference maneuvers.	Analyze
CO 5	Perform take offs and Landings.	Analyze

Laboratory Components

S. No.	Exercises	CO Mapping	Blooms Level
11.	Aircraft “Jacking Up” procedure	CO1	Understand
12.	Aircraft “Levelling” procedure	CO1	Understand
13.	Control System “Rigging check” procedure	CO1	Understand
14.	Aircraft “Symmetry Check” procedure	CO1	Understand
15.	Introductory Flight	CO2	Understand
16.	Four Fundamentals of the flight	CO2	Analyze
17.	Slow Flight and Stall Recovery	CO3	Analyze
18.	Emergency procedures	CO3	Analyze
19.	Traffic Pattern Review	CO4	Analyze
20.	Performance Take offs and Landings	CO5	Analyze

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of the equipment	Quantity	Experiment No.
14.	Serviceable aircraft with all above systems	1	1 to 4
15.	Hydraulic Jacks (Screw Jack)	3	1,2,4
16.	Trestle adjustable	2	1,2,4
17.	Spirit Level	3	1,2,4
18.	Cable Tensiometer	1	1,2,4,7
19.	Plumb Bob	1	3,7
20.	Internal server (or) Work station	1	5 to 10
21.	Flight Simulator package(Open Source)	30	5 to 10
22.	Computers	30	5 to 10
23.	UPS	1	5 to 10

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	-	-	-	-	2	-	-	-	2	-	-
CO2	3	3	3	3	-	-	-	-	2	-	-	-	2	-	-
CO3	3	3	3	3	-	-	-	-	2	-	-	-	2	-	-
CO4	3	3	2	3	-	-	-	-	2	-	-	-	2	-	-
CO5	3	3	2	3	-	-	-	-	2	-	-	-	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			
Analyze			
Evaluate	60	60	60
Create			

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20AE705	Design Project	L	T	P	C
		0	0	2	1
Nature of Course	Employability Enhancement Courses				
Pre requisites	Aircraft Design				

Course Objectives

The course is intended to

1. To know about the aircraft on comparing them
2. To learn about the weigh estimation and design parameters
3. To understand the preliminary design of an aircraft
4. Ways to learn the load distribution of an aircraft
5. To draw CAD drawings about aircraft three view

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Getting knowledge about different types of airplanes	Apply
CO2	Understanding the weight estimation and design parameters	Apply
CO3	Gaining knowledge about the preliminary design of an aircraft	Apply
CO4	Creating aircraft design on balancing and maneuvering loads	Apply
CO5	Learn about three view of the aircraft drawing	Apply

Course contents:

1. Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work under taken.
2. Preliminary weight estimation, Selection of design parameters, power plant selection, aerofoil selection, fixing the geometry of Wing, tail, control surfaces Landing gear selection.
3. Preliminary design of an aircraft wing – Shrenck's curve, structural load distribution, shear force, bending moment and torque diagrams
4. Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage
5. Design of control surfaces - balancing and maneuvering loads on the tail plane and aileron, rudder loads
6. Preparation of a detailed design report with CAD drawings

Total: 45 Periods

Text books:

1. Raymer, D.P. Aircraft conceptual Design, AIAA series, 5th edition, 2012.
2. Torenbeck, E. Synthesis of Subsonic Airplane Design, Delft University Press, U.K. 1986.

References:

1. Kuechemann, D, "The Aerodynamic Design of Aircraft, American Institute of Aeronautics publishers, 2012

Additional references:

1.https://nptel.ac.in/courses/101/104/101104069/

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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	3	3	3	2	-	-	3	-	2	-	3	2	3
CO2	3	3	3	3	3	2	-	-	3	-	2	-	3	2	3
CO3	3	3	3	3	3	2	-	-	3	-	2	-	3	2	3
CO4	3	3	3	3	3	2	-	-	3	-	2	-	3	2	3
CO5	3	3	3	3	3	2	-	-	3	-	2	-	3	2	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			
Analyze			
Evaluate	60	60	60
Create			

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Professional Elective

STREAM – 1 AERODYNAMICS

20AEE01	**Low Speed Aerodynamics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective				
Pre requisites	Fluid mechanics				

Course Objectives

The course is intended to

1. To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
2. To provide the mathematical understanding of basic flows and their combinations.
3. To understand the Theory of Aero foil And Wing Sections.
4. To understand the vortex filament and lifting line theory.
5. To introduce the conceptual boundary layer thickness.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	To apply governing equation to various fluid flow models	Apply
CO2	Able to apply the knowledge of basic flows to the various bodies in the atmosphere for thegeneration of lift	Apply
CO3	Able to solve the aerodynamic problems associated with the airfoils and the transformation.	Apply
CO4	Able to simulate wings with help of aerodynamic tools for various ambient conditions.	Apply
CO5	Knowledge on incompressible flow and viscous flow.	Apply

Course contents:

UNIT I Basic Aerodynamics **6**

Continuity, momentum and energy equations-Differential and Integral forms

UNIT II Two Dimensional Flows and Generation of Lift **12**

Basic flows – Source, Sink, Free and Forced vortex, uniform parallel flow. Their combinations, Pressure and velocity distributions on bodies with and without circulation in ideal and real fluid flows KuttaJoukowski's theorem, Kutta condition.

UNIT III Conformal Transformation and Airfoil Theory **11**

Cauchy-Riemann relations, complex potential, methodology of conformal transformation, Kutta Joukowski transformation and its applications. Thin airfoil theory and its applications.

UNIT IV Subsonic Wing Theory **8**

Vortex filament, Biot and Savart law, bound vortex and trailing vortex, horse shoe vortex, lifting line theory and its limitations.

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UNIT V Introduction to Boundary Layer **8**

Newton's law of viscosity, Boundary Layer, Navier-Stokes equation, displacement, Momentum thickness, Flow over a flat plate, Blasius solution.

Total: 45 Periods

Text books:

1. Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1982.
2. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., 6th edition, 2016.

Reference books:

1. John J Bertin., "Aerodynamics for Engineers", Pearson Education Inc, 2002
2. Clancey, L J.," Aerodynamics", Pitman, 1986
3. Milne Thomson, L.H., "Theoretical aerodynamics", Macmillan, 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	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	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 (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20AE503	Compressible Flow Aerodynamics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Low Speed Aerodynamics				

Course Objectives

The course is intended to

1. To introduce the concepts of compressibility and flow through convergent- divergent nozzle,
2. To make the student understand the theory behind the formation of shocks and expansionfans in Supersonic flows.
3. To make the student recognize the shock wave problems in supersonic flows.
4. To understand the Linearized flow theory for streamlined bodies.
5. To study the fundamental of compressible flow equations and transonic flow over wing

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 continuum, compressibility, and calculate the compressible flow through a duct of varying cross section.	Apply
CO2	To understand about the formation of normal and oblique shocks	Understand
CO3	Solve numerical problemsrelated to shock wavein supersonic flow and design concept of supersonic nozzle.	Apply
CO4	Apply the Linearized flow theory for streamlined bodies	Apply
CO5	Apply the concepts to increase the performance of an aircraft during transonic and supersonicspeeds	Apply

Course contents:

UNIT I One Dimensional Compressible Flow **10**

Continuity, Momentum, Energy and state equations, adiabatic steady state flow equations, velocity of sound, Flow through convergent- divergent passage, Performance under various back pressures.

UNIT II Normal and Oblique Shocks **12**

Prandtl equation and Rankine – Hugonoit relation, Normal shock equations, Pitot static tube,corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations,Hodograph and pressure turning angle, shock polar, flow past wedges and concave corners,strong, weak and detached shocks

UNIT III Expansion Waves and Method of Characteristics **8**

Flow past convex corners, Expansion hodograph, Reflection and interaction of shocks andexpansion, waves. Method of Characteristics Two dimensional supersonic nozzle contours.Rayleigh and Fanno Flows.

UNIT IV Differential Equations of Motion for Steady Compressible Flows **7**

Small perturbation potential theory, Prandtl-Glauert rule - affine transformation relations for subsonic flows, Linearized two dimensional supersonic flow theory - Lift, drag, pitching moment and center of pressure of supersonic profiles.

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UNIT V High Speed Flow Over Wing **8**

Lower and upper critical Mach numbers, Lift and drag, divergence, Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, transonic area rule. Introduction to Hypersonic Aerodynamics.

Total: 45 Periods

(Use of Standard and approved Gas Tablesare permitted)

Text books:

4. Anderson Jr., D., – "Modern compressible flows", McGraw-Hill Book Co., New York, 1999.
5. L.J. Clancy, "Aerodynamics" Sterling Book House, 2006
6. Rathakrishnan, E., "Gas Dynamics", 6th Edition, Prentice Hall of India, 2017.

References:

4. Shapiro, A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press,1982
5. Zucrow, M.J. and Anderson, J.D., "Elements of gas dynamics", McGraw-Hill Book Co. New York, 1989.
6. J. D. Anderson, "Fundamentals of Aerodynamics", Fifth Edition, McGraw Hill Education IndiaPrivate Limited, 2010.

Additional references:

1. http://nptel.ac.in/courses/112103021/
2. http://nptel.ac.in/courses/101106044/
3. https://nptel.ac.in/courses/101/105/101105059/

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	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	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	

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE03	BOUNDARY LAYER THEORY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Basics of Fluid Mechanics, Aerodynamics I, Computational Fluid Dynamics				

Course Objectives

The course is intended to

1. To learn the fundamentals of Boundary Layer Theory.
2. To study the fluid flows and flow separation.
3. To study about wind tunnel techniques.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Know about the basic fundamentals of Different types of Boundary layer thickness	Apply
CO2	Understand the behaviour of the fluid flow under static condition	Apply
CO3	Understand the basics of different types of flows such as laminar, turbulent and compressible. Incompressible, viscid and inviscid flow	Apply
CO4	Know the basics of flow separation and boundary layer control	Understand
CO5	Know more about analytic techniques and wind tunnel experiments.	Apply

Course contents:

Unit I Basic Concepts of Viscous Flows **9**

Introduction to hydrodynamic andthermal boundary layer theory, flow over the flat plate at zero incidences, Boundarylayer thickness, momentum thickness,energy thickness, boundary layer equation and their generalproperties.

Unit II Solutions to Boundary Layer Flows **9**

Method of exact solution-Blassius solution to boundary layer problems,Approximate solutions – Von Karman solution to boundary layerflows over the flat plate, flow with pressure gradient, flow over acylinder, plane Couette flow, circular Couette flow Betweenparallel plates.

Unit III Transition **9**

Pipe flow and flow over a flat plate, critical Reynolds number,turbulents, principles of theory of stability of Laminar flows,Summerfield equation, factors effecting transition, Laminar aerofoils

Unit IV Turbulent Baoundary Layers **9**

Fundamentals of turbulent flow, Mean motion fluctuations, ReynoldsEquations, Reynolds stresses, wind tunnel turbulence, Prandtl'smixing length theory, velocity distribution laws.

Unit V Boun Dary Layer Control and Thermal Boundary Layer **9**

Causes of boundary layerseparation. Heattransfer from cold surface,thermal boundary layer growth over the hot and cold surface, flowover the flat plate with different flow conditions with heat transfer, Reynolds analogy andColburn analogy, non-dimensional numbers governing Boundarylayer flows.

Total: 45 Periods

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Text books:

1. H Schlichting - Boundary-Layer TheoryPublished May 20th 2003 by Springer – available in Indian Edition

References:

1. J.O. Hinze -Turbulence: An Introduction to Its Mechanism and Theory 1959
2. Guy Métivier - Small Viscosity and Boundary Layer Methods: Theory, Stability Analysis, and Applications (Modeling and Simulation in Science, Engineering and Technology) 1st ed. 2004 Edition, Kindle Edition.

Additional references:

1. https://www.springer.com/in/book/9783662529171
2. https://www.elsevier.com/books/boundary-layer-and-flow-control/lachmann/978-1-4832-1323-1

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	-	-	-	-	-	-	-	2	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO5	3	3	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 (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE04	Viscous Flow Theory	L	T	P	C
		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Aerodynamics, Engineering Physics				

Course Objectives

The course is intended to

1. To learn basic knowledge of Aerodynamics.
2. To study about Aerodynamic Flows
3. To impact the study of viscous flow

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Understand the Interpret ideal and Real fluid flows on boundary layer perspective.	Understand
CO 2	Examine laminar incompressible and compressible viscous flows.	Understand
CO 3	Summarize transition phenomenon in incompressible and compressible flows	Understand
CO 4	Apply the statistical mechanics to predict the turbulent flow behavior	Apply

Course Contents

Unit –I Introduction **9**

Boundary layer on an airfoil, Boundary layer separation, Derivation of the Equations of Motion: Review of Cartesian tensor notation – Derivation of the full compressible viscous Newtonian equations – Conservation of mass, momentum, energy – Vorticity and entropy equations – Kelvin's theorem – Introduction to Non-Newtonian fluids.

Unit –II Laminar Incompressible Viscous Flow **9**

Exact solutions: stagnation point flow, Jeffrey-Hamel flow, Stokes problems – Low Reynolds number flow – Introduction to perturbation theory – Boundary layer theory – Effects of pressure gradient and curvature – Boundary layer integral equations – Thwaites method.

Unit –III Laminar Compressible Viscous Flow **9**

Exact solutions: compressible Couette flow, flow through a shock wave – Compressible boundary layers – Introduction to shock-boundary layer interaction and hypersonic effects: dissociation, heating, and non-equilibrium thermodynamics.

Unit –IV Transition To Turbulence **9**

Linear transition theory – Introduction to nonlinear theory and numerical methods – Introduction to experimental results in bounded and free shear flows, both incompressible and compressible – Effects of roughness, turbulence, vibration, noise, curvature, etc – Transitionseparation interactions in boundary layers.

Unit –V Turbulent Flow **9**

Introduction to Turbulent Flow: Reynolds averaged equations of motion – Law of the wall in the turbulent boundary layer – Introduction to experimental results for various fundamental turbulent flows – Bluff bodies, internal flows, free shear flows.

Total : 45 Periods

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Text Books

1. Frank M. White, 'Viscous Fluid Flow', Third Edition, Tata McGraw Hill Pvt Ltd., New Delhi, 2011.
2. H.Schlichting and K.Gersten, 'Boundary Layer Theory', Ningth Edition, Springer, 2017.

Reference Books

1. Carl M. Bender and Steven A. Orszag, 'Advanced Mathematical Methods for Scientists and Engineers I: Asymptotic Methods and Perturbation Theory', SpringerVerlag, New York, 2013.
2. Rutherford Aris, 'Vectors, Tensors and the Basic Equations of Fluid Mechanics', Dover Publications, 2012.

Additional / Web References

1. https://ocw.mit.edu/courses/mechanical-engineering/2-25-advanced-fluid-mechanicsfall-2013/equations-of-viscous-flow/
2. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-13-aerodynamics-ofviscous-fluids-fall-2003/
3. https://nptel.ac.in/courses/Webcourse-contents/Iit-Kanpur/FluidMechanics/Ui/Course_Home-8.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**	**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	

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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				

CHAIRMAN - BOARD OF STUDIES

20AEE05	Industrial Aerodynamics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Aerodynamics				

Course Objectives

The course is intended to

1. To build up necessary background for understand the aerodynamic aspects of wind generators, automobiles, buildings etc.
2. To introduce the basics of wind energy collectors.
3. To learn the aerodynamics important in recent vehicle industries.
4. To understand the application of various aerodynamic aspects in vehicles and buildings etc.,
5. To realize the effect of vibrations and Reynolds numbers.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Apply the basic wind characteristics.	Understand
CO2	Realize the historical development of wind turbine, its components and classifications.	Understand
CO3	Apply the aerodynamic effects in road vehicle and analyze the various method of drag reduction.	Apply
CO4	Analyze the aerodynamics of low rise buildings and high rise building for deign good ventilation.	Apply
CO5	Explore the effect of Reynolds number on wake formation of bluff shapes.	Understand

Course contents:

UNIT I Atmosphere **9**

Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

UNITII Wind EnergyCollectors **9**

Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

UNIT III Vehicle Aerodynamics **9**

Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.

UNIT IV Building Aerodynamics **9**

Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics.

UNIT V Flow Induced Vibrations **9**

Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, galloping and stall flutter.

Total: 45 Periods

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Text books:

1. M.Sovran (Ed), “Aerodynamics and drag mechanisms of bluff bodies and Road vehicles”, Plenum press, New York, 1978.
2. Sachs. P., “Winds forces in Engineering”, Pergamon Press, 1978.

References:

1. Blevins. R.D., “Flow Induced Vibrations”, Van Nostrand, 1990.
2. Calvent. N.G., “Wind Power Principles”, Charles Griffin & Co., London, 1979.

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	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	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 (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE06	AERO ACOUSTICS	L	T	P	C
		3	0	2	4
Nature of Course	Proffesional Core				
Pre requisites	Engineering Physics				

Course Objectives

The course is intended to

1. To impart the knowledge on fundamentals of sound.
2. To impart the knowledge on sound reflection, refraction, diffraction and diffusion.
3. To impart the knowledge on sound absorption & absorption testing.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the premilary of sound levels and their units.	Understanding
CO2	Understand the behavior of sound in free fields and Reflection of sound.	Understanding
CO3	Obtain knowledge on sound diffraction and refraction.	Understanding
CO4	Obtain knowledge on sound reverberation and diffusion field	Apply
CO5	Obtain knowledge on sound absorption and absorption quantifying methods.	Apply

Course contents:

Unit I Fundamentals of Sound And Sound Levels **9**

Sine wave and Complex wave. Octave and Decibels. Acoustic Power, Sound intensity and Sound Pressure Level measurement.

Unit II Sound In Free Filed And Reflection **9**

Sound Divergence, Sound intensity in free field, Sound field in an enclosed spaces, specular reflection, Reflection from concave, convex and parabolic surfaces. Standing waves. Corner reflection.

Unit III Diffraction and Refraction **9**

Wavefront propagation and diffraction of sound by obstacles, Apertures, Slit and Various diffusion objects- Reflection of sound in solid, atmosphere, enclosed space and Ocean.

Unit IV Reverberation **9**

The perfectly diffused sound field,Evaluation of diffusion in a room, concave surface and convex surface. Decay of sound in room, Reverberation time calculation and measurement

Unit V Absorption **9**

Dissipation of sound energy, Absorption coefficient - Glass fibre , Insulation materials, effect of thickness and density of Absorbents.

Total: 45 Periods

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Text Books:

1. Alton F. Everest, “The Master Handbook of Acoustics”, McGraw-Hill Companies publisher, 2002
2. Glen M Ballou, “Handbook for Sound Engineers”, Elsevier, Focal Press, 2008.

References:

1. Jerry H. Ginsberg, “Acoustics-A Textbook for Engineers and Physicists, Volume I Fundamentals”, ASA Press, Springer 2018.
2. Jerry H. Ginsberg, “Acoustics-A Textbook for Engineers and Physicists, Volume II – Applications”, ASA Press, Springer 2018.
3. Carl Q Howard_ Benjamin S Cazzolato, “Acoustic analyses using Matlab and Ansys” - CRC, Taylor and Francis, 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**	**3**
CO1	3	2	3											2	
CO2	3	2	3											2	
CO3	3	2	3											2	
CO4	3	3	2											2	
CO5	3	2	3											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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE07	Flight Instrumentation	L	T	P	C
		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Aircraft System and Instruments				

Course Objectives

The course is intended to

1. Impart knowledge on the cockpit displays.
2. Provide knowledge on transmission systems.
3. Impart knowledge gyroscope and its operations.
4. Provide knowledge on flight management systems
5. Impart knowledge on power plant instruments.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Identify the concept of instruments and display panels	Understand
CO 2	Classify the air data instruments and transmission systems	Understand
CO 3	Relate the gyroscopic instruments	Understand
CO 4	Identify the Aircraft compass and managements systems	Understand
CO 5	Identify the power plant instruments	Understand

Course Contents

Unit –I Measurement Science and Displays **9**

Instrumentation brief review-Concept of measurement-Errors and error estimation- Functional elements of an instrument system –Transducers - classification - Static and dynamic characteristics-calibration - classification of aircraft instruments - Instrument display panels and cockpit layout.

Unit –II Air Data Instruments and Synchro Transmission Systems **9**

Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement, Synchronous data transmission system

Unit –III Gyroscopic Instruments **9**

Gyroscope and its properties, gyro system, Gyro horizon, Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, Turn coordinator, acceleration and turning errors.

Unit –IV Aircraft Compass Systems and Flight Management System **9**

Direct reading compass, magnetic heading reference system-detector element, monitored gyroscope system, DGU, RMI, deviation compensator. FMS- Flight planning-flight path optimization-operational modes-4D flight management.

Unit –V Power Plant Instruments **9**

Pressure measurement, temperature measurement, fuel quantity measurement, engine power and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, fuel flow, engine vibration, monitoring.

Total : 45 Periods

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Text Books

1. Doeblin.E.O, “Measurement Systems Application and Design”, McGraw-Hill, New York, 1999.
2. HarryL.Stilz, “Aerospace Telemetry”, Vol I to IV, Prentice-Hall Space Technology Series.

Reference Books

1. Murthy, D.V.S., “Transducers and Measurements”, McGraw-Hill, 1995
2. Pallet, E.H.J. “Aircraft Instruments & Integrated systems”, Longman Scientific and Technical, McGraw-Hill, 1992.

Additional / Web References

1. https://nptel.ac.in/courses/101/108/101108056/
2. https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/media/10_phak_ch8.pdf
3. https://www.aircraftsystemstech.com/2017/04/aircraft-instrument-systems.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**
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**
	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				

CHAIRMAN - BOARD OF STUDIES

20AEE08	AIR TRAFFIC CONTROL AND PLANNING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Aircraft Systems & Instruments				

Course Objectives

The course is intended to

1. Improve the basic concepts of air traffic control.
2. Analyze some real problem in air traffic systems
3. Familiarize flight information system.
4. Improve the basic knowledge in aerodrome data.
5. Provide the foundation of navigation and other data.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the basic concepts of air traffic control	Understand
CO2	Remember the air traffic system	Understand
CO3	Understand the flight information system	Understand
CO4	Remember the basic knowledge in aerodrome data	Understand
CO5	Remember the foundation of navigation and other data	Understand

Course contents:

Unit I Basic Concepts **9**

Objectives of air traffic control systems - Parts of ATC services – Scope and Provision of ATCs – VFR & IFR operations – Classification of ATS air spaces – Various kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.

Unit II Air Traffic Systems **9**

Area control service, assignment of cruising levels - minimum flight altitude - ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance –ATC clearances – Flight plans – position report

Unit III Flight Information Systems **10**

Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and co-ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

Unit IV Aerodrome Data **9**

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical

Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.

Unit V Navigation and Other Services **8**

Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.

Total: 45 Periods

Text Book

1. AIP (India) Vol. I & II, "The English Book Store", 17-1, Connaught Place, New Delhi.

References

1. "Aircraft Manual (India) Volume I", latest Edition – The English Book Store, 17-1, Connaught Place, New Delhi.
2. "PANS – RAC – ICAO DOC 4444", Latest Edition, The English Book Store, 17-1, Connaught Place, New Delhi.

Additional references:

1. https://nptel.ac.in/courses/105/101/105101008/
2. https://nptel.ac.in/courses/101/108/101108047/

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	2	3	-	-	-	-	-	-	-	1	2	-	-
CO2	2	2	2	3	-	-	-	-	-	-	-	1	2	-	-
CO3	2	2	2	3		-	-	-	-	-	-	1	2	-	-
CO4	2	2	2	3	-	-	-	-	-	-	-	1	2	-	-
CO5	2	2	2	3	-	-	-	-	-	-	-	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	

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20AEE09	Behavior of Material at High Temperature	L	T	P	C
		3	0	0	3
Nature of Course	Programme Elective				
Pre requisites	Strength of Materials Aero engineering thermodynamics				

Course Objectives:

The course is intended to

1. To learn damage mechanism and failure of components of elevated temperatures

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand and describe the properties of material under constant load at elevated temperature.	Understand
CO2	Have knowledge in improving material strength against high temperature environment and predict life time.	Apply
CO3	Explain the types of fracture mechanisms for various materials and alloys	Understand
CO4	Discuss oxidation and corrosion effect on materials due to elevated temperature	Analyze
CO5	Explains the properties of super alloys and its hardening processes	Evaluate

Course Contents:

Unit I Creep **9**

Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress,temperature and strain rate.

Unit II Design for Creep Resistance **9**

Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

Unit III Fracture **9**

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

Unit IV Oxidation and Hot Corrosion **9**

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

Unit V Superalloys and Other Materials **9**

Principles and applications - Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy - principal steps involved, advantages and limitations

Total: 45 Periods

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Text books:

1. Raj. R., “Flow and Fracture at Elevated Temperatures”, American Society for Metals, USA,1985.
2. Hertzberg R. W., “Deformation and Fracture Mechanics of Engineering materials”, 4th Edition, John Wiley, USA, 1996.
3. Courtney T.H, “Mechanical Behavior of Materials”, McGraw-Hill, USA, 1990.

References:

1. Boyle J.T, Spencer J, “Stress Analysis for Creep”, Butterworths, UK, 1983.
2. Bressers. J., “Creep and Fatigue in High Temperature Alloys”, Applied Science, 1981.
3. McLean D., “Directionally Solidified Materials for High Temperature Service”, The Metals Society, USA, 1985.

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	1	1			
CO 2		3		1	3				1		1	1			
CO 3		3	1	1	3				1		1	1			
CO 4	1	3	1	3	3				1		1				
CO 5	3	3	1	1	3				3	1	1	1			
	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				

CHAIRMAN - BOARD OF STUDIES

20AEE10	Experimental Aerodynamics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Low Speed Aerodynamics				

Course Objectives

The course is intended to

1. To impart knowledge on measurement techniques in aerodynamic flow.
2. To acquire basics concepts of wind tunnel measurement systems and balancing.
3. To describe flow visualization techniques and to highlight in depth discussion of analog methods.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Analyze the experimental studies in fluid mechanics and apply different measurement techniques.	Understand
CO2	Utilize wind tunnel balance for aerodynamic measurements.	Apply
CO3	Demonstrate flow visualization techniques	Apply
CO4	Measure pressure, velocity and temperature in low & high-speed flows.	Apply
CO5	Analyze the special flows and uncertainty problems.	Understand

Course contents:

UNIT I Basic Measurements in Fluid Mechanics **7**

Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements - Analogue methods – Flow visualization – Components of measuring systems – Importance of model studies.

UNIT II Wind Tunnel Measurements **10**

Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels - Power losses in a wind tunnel – Instrumentation and calibration of wind tunnels – Turbulence-Wind tunnel balance – Wire balance – Strut-type – Platform-type – Yoke-type – Pyramid type – Strain gauge balance – Balance calibration.

UNIT III Flow Visualization and Analogue Methods **9**

Visualization techniques – Smoke tunnel – Hele-Shaw apparatus - Interferometer – Fringe-Displacement method – Schlieren system – Shadowgraph - Hydraulic analogy – Hydraulic jumps – Electrolytic tank.

UNIT IV Pressure, Velocity and Temperature Measurements **9**

Pitot - static tube characteristics - Velocity measurements - Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Pressure measurement techniques - Pressure transducers – Temperature measurements.

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UNIT V Special Flows and Uncertainty Analysis **10**

Experiments on Taylor-Proudman theorem and Ekman layer – Measurements in boundary layers - Data acquisition and processing – Signal conditioning – Uncertainty analysis – Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty calculation - Uses of uncertainty analysis.

Total: 45 Periods

Text books:

1. Rathakrishnan, E., “Instrumentation, Measurements, and Experiments in Fluids,” CRC Press – Taylor & Francis, 2007.
2. Robert B Northrop, “Introduction to Instrumentation and Measurements”, Second Edition, CRC Press, Taylor & Francis, 2006.

References:

1. Bradsaw "Experimental Fluid Mechanics", Elsevier, 2nd edition, 1970.
2. Pope, A., and Goin, L., "High Speed Wind Tunnel Testing", John Wiley, 1985.

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	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	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 (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE11	Helicopter Aerodynamics	L	T	P	C
		3	2	0	4
Nature of Course	Professional Core				
Pre requisites	Aerodynamics and Engineering Physics				

Course Objectives

The course is intended to

1. To impart the knowledge of basic layout of helicopter.
2. To impart the knowledge of aerodynamics of helicopter.
3. To impart the knowledge to design a rotor blade.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the various configuration propulsive devices and its performances at different flight conditions.	Understand
CO2	Apply the fundamental knowledge types of helicopter and its control system.	Apply
CO3	Understand the momentum theory, power estimation and constant chord and ideal twist rotors	Understand
CO4	Understand power requirements, performance Curves, variation altitude in forward flight and helicopter stability	Apply
CO5	Understand Hovercraft types, lift augmentation and power calculations of plenum chambers, applications	Understand

Course Contents:

Unit I Lift, Propulsion and Control of V/STOL Aircraft **9**

Various configurations - propeller, rotor, ducted fan and jet lift-Tilt wing and vectored thrust - performance of VTOL and STOL aircraft in hover, transition and forward motion.

Unit II Elements of Helicopter Aerodynamics **9**

Configurations based on torque reaction - Jet rotors and compound helicopters - Methods of control - collective and cyclic pitches changes - Lead - lag and flapping hinges.

Unit III Ideal Rotor Theory **9**

Hovering performance - Momentum and simple blade element theories - Figure of merit - Profile and induced power estimation - Constant chord and ideal twist rotors.

Unit IV Power Estimates **9**

Induced, profile and parasite power requirements in forward flight - performance curves with effects of altitude - Preliminary ideas on helicopter stability.

Unit V Ground Effect Machines 9

Types - Hover height, lift augmentation and power calculations for plenum chamber and peripheral jet machines - Drag of hovercraft on land and water. Applications of hovercraft.

Total: 45 Periods

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Text Books:

1. B.W. Mc Cormic, "Aerodynamics of V/STOL Flight", Academic Press, New York, 1978.

Reference Books:

1. Gessow and G.C.Meyers, "Aerodynamics of the Helicopter", Macmillan and Co., New York, 1982.
2. G.H. Elsley and A.J. Devereux, "Hovercraft Design and Construction, David Charies, London, 1982.
3. Anderson J.D. "Aerodynamics", John Wiley, 1995.

Additional References:

1. https://www.abebooks.com/9780521660600/Principles-Helicopter-Aerodynamics-Cambridge-Aerospace-0521660602/plp

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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20AEE12	Civil Aviation Requirements	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Aircraft General Engineering and Maintenance Practices				

Course Objectives:

The course is intended to

1. Provide knowledge on the Indian aviation rules 1937 relating to aviation.
2. Knowledge on and civil aviation requirement in India (DGCA).
3. Impart knowledge on aircraft maintenance.
4. Provide knowledge on inspection.
5. Impart knowledge on Flight Test.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Know the procedure for keeping the aircraft in airworthiness conditions and describe the use of MEL, and the procedure for releasing the Aircraft under MEL.	Understand
CO2	Describe the different types of maintenance program.	Understand
CO3	Comprehend the requirements for getting AO in different categories	Understand
CO4	Describe the overhaul and inspection procedure of various instruments	Understand
CO5	Describe the detail procedure of flight test	Understand

Course Contents

Unit –I C.A.R SERIES 'A' - Procedure for Civil Air Worthiness Requirements and Responsibility Operatorship -A-Vis Airworthiness Directorate **9**

Responsibilities of operators / owners; Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators. C.A.R. SERIES 'B' - ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, and CDL - Deficiency list (MEL & CDL); Preparation and use of cockpit check list and emergency list.

Unit –II C.A.R. SERIES 'C' - Defect Recording, Monitoring, Investigation and Reporting **9**

Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-fight readings & recordings; Maintenance control by reliability Method.C.A.R. SERIES 'D' - AND AIRCRAFT MAINTENANCE PROGRAMMES Reliability Programme (Engines); Aircraft maintenance programme& their approval; On condition maintenance of reciprocating engines; TBO - Revision programme - Maintenance of fuel and oil uplift and consumption records - Light aircraft engines; Fixing routine maintenance periods and component TBOs - Initial & revisions.

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Unit –III C.A.R. SERIES 'E' - Approval of Organizations **9**

Approval of organizations in categories A, B, C, D, E, F, & G; Requirements of infrastructure at stations other than parent base.C.A.R. SERIES 'F' - air worthiness and continued air worthiness: Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

Unit –IV C.A.R. SERIES 'L' - Aircraft Maintenance Engineer - Licensing **9**

Issue of AME License, its classification and experience requirements, Complete Series 'L'.C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS: Mandatory Modifications /Inspections.

Unit –V C.A.R. SERIES 'T' - Flight Testing of Aircraft **9**

Flight testing of (Series) aircraft for issue of C of A; Fight testing of aircraft for which C or A had been previously issued. C.A.R. SERIES 'X' - MISCELLANEOUS REQUIREMENTS: Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of taxy permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

Total : 45 Periods

Text Books

4. "Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 171, Connaught Circus, New Delhi.

Reference Books

6. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi.
7. "Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA. AdvisoryCirculars ", form DGCA.

Additional / Web References

2. http://164.100.60.133/dgca/dgca-ind.htm
3. https://www.gcaa.gov.ae/en/epublication/pages/cars.aspx

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	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO5	2	-	-	-	-	-	-	-	-	2	-	-	2	-	-
	3	High				2	Medium					1	Low		

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20AEE13	Aircraft Rules and Regulations	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Fundamentals of Aeronautical Engineering				

Course Objectives

The course is intended to

1. Provide knowledge on the Indian aviation rules 1937 relating to aviation.
2. Knowledge on and civil aviation requirement in India (DGCA).
3. Impart knowledge on aircraft maintenance.
4. Provide knowledge on inspection.
5. Impart knowledge on Flight Test.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Know the procedure for keeping the aircraft in airworthiness conditions and describe the use of MEL, and the procedure for releasing the Aircraft under MEL.	Understand
CO2	Describe the different types of maintenance program.	Understand
CO3	Comprehend the requirements for getting AO in different categories	Understand
CO4	Describe the overhaul and inspection procedure of various instruments	Understand
CO5	Describe the detail procedure of flight test	Understand

Course Contents:

UNIT I C.A.R. SERIES 'A' – PROCEDURE FOR CIVIL AIR WORTHINESS REQUIREMENTS AND RESPONSIBILITY OPERATORS Vis-à-vis AIR WORTHINESS DIRECTORATE 9

Responsibilities of operators / owners- Procedure of CAR issue, amendments etc.,Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operator C.A.R. SERIES 'B' – ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, CDL: Deficiency list (MEL & CDL); Preparation and use of cockpit checklist and emergency list.

UNIT II - C.A.R. SERIES 'C' – DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING 9

Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-flight readings & recordings; Maintenance control by reliability Method.

UNIT III -C.A.R. SERIES 'D' – AND AIRCRAFT MAINTENANCE PROGRAMMES 9

Reliability Programmes (Engines); Aircraft maintenance programme & their approval; On condition maintenance of reciprocating engines; TBO – Revision programme; Maintenance of fuel and oil uplift and consumption records – Light aircraft engines; Fixing routine maintenance periods and component TBOs – Initial & revisions.

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UNIT IV C.A.R. SERIES 'E' – APPROVAL OF ORGANISATIONS **9**

Approval of organizations in categories A, B, C, D, E, F, & G - Requirements of infrastructure at stations other than parent base.C.A.R. SERIES 'F' – AIR WORTHINESS AND CONTINUED AIR WORTHINESS: Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

UNIT V- C.A.R. SERIES 'L'&'M' **9**

Issue of AME Licence, its classification and experience requirements, Mandatory Modifications / Inspections.

Total: 45 Periods

Text Books:

1. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness)" – Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi 2000.
2. Aeronautical Information Circulars (relating to Airworthiness) from DGCA 2000.

Reference Books:

1. "Aircraft Manual (India) Volume" – Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2. Advisory Circulars from DGCA 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	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO5	2	-	-	-	-	-	-	-	-	2	-	-	2	-	-
	3	High				2	Medium					1	Low		

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

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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

STREAM – 2 PROPULSION

20AEE21	Space Mechanics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Rocket & Space propulsion				

Course Objectives

The course is intended to

1. To understand and use the concept of satellite motion to assess its trajectories
2. To study the basic concepts of Orbital Mechanics with particular emphasis on interplanetary trajectories and satellite system
3. To evaluate the working of the missile system and its trajectory

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Analyze the application of the basic concepts of space mechanics	Understand
CO2	Evaluate the trajectories of the satellite using the N-body concept	Apply
CO3	Analyze parameters to identify satellite injection, motion and determine the causes for perturbation	Apply
CO4	Evaluate terminologies and system to design and determine interplanetary trajectories	Apply
CO5	Analyze the working of ballistic missile and its design parameters	Understand

Course Contents:

Unit I Basic Concepts **9**

The solar system - references frames and coordinate systems - the celestial sphere - the ecliptic – motion of vernal equinox - sidereal time - solar time - standard time.

Unit II The General N-Body Problem **9**

The many body Problem - Lagrange - Jacobian Identity -The Circular Restricted Three Body Problem - Libration Points- Relative Motion in the N-body Problem -Two Body Problem - Satellite Orbits - Relations Between Position and Time.

Unit III Satellite Injection and Satellite Orbit Perturbations **9**

General aspects of satellite injections - satellite orbit transfer -various cases - orbit deviations due to injection errors - special and general perturbations - Cowells method - Encke- method - General perturbations approach.

Unit IV Interplanetary Trajectories **9**

Two dimensional interplanetary trajectories -fast interplanetary trajectories - three dimensional interplanetary trajectories - launch if interplanetary spacecraft -trajectory about the target planet.

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Unit V Ballistic Missile Trajectories and Materials **9**

The boost phase - the ballistic phase -trajectory geometry- optimal flights - time of flight - re-entry phase- the position of the impact point - influence coefficients. Space environment - peculiarities - effect of space environment on the selection of spacecraft material.

Total: 45 Periods

Text Books:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamic", W.H. Freeman & Co., 2012.
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 2019.

Reference Books:

1. Howard D. Curtis., "Orbital Mechanics for Engineering Students", Elsevier, 2015.
2. Francis J Hale., "Introduction to Space Flight", Prentice Hall, 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**	**3**
CO1	3	3	2	2	2	-	-	-	-	-	1	2	3	2	3
CO2	2	3	2	2	2	-	-	-	-	-	1	2	3	2	3
CO3	3	3	2	2	2	-	-	-	-	-	1	2	2	2	3
CO4	2	2	2	2	2	-	-	-	-	-	-	2	2	2	3
CO5	3	2	3	2	2	-	-	-	-	-	1	2	2	2	3
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom'sLevel	**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				

CHAIRMAN - BOARD OF STUDIES

20AEE22	Cryogenic Engineering	L	T	P	C
		3	0	0	3
Nature of course	Professional Electives				
Pre requisites	Aero Engineering Thermodynamics and Heat Transfer				

Course Objectives

The course is intended to

1. To give the introduction og cryogenic engineering
2. To implement the properties of cryogenics
3. To make the students to learn about the cryogenic system
4. To gain the knowledge on storage and instrumentation of cryogenics
5. To learn the procedure of usage of cryogenic equipment

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Learn about the cryogenic engineering basics	Understand
CO 2	Gaining knowledge about the properties of cryogenics	Apply
CO 3	Learn about insulation of cryogenic system	Apply
CO 4	Insisting the properties of storage and instrumentation of cryogenics	Apply
CO 5	Learn about the usage cryogenic equipments	Understand

Course Contents:

Unit –I Introduction to Cryogenic Engineering **9**

Thermo physical and fluid dynamic properties of liquid and gas hydrogen, Thermo physical and fluid dynamic properties of liquid and gas helium, Liquefaction systems of hydrogen and helium gases, Joule Thomson effect and inversion curve; Adiabatic and isenthalpic expansion with their comparison

Unit –II Properties of Cryogenics **9**

Cryogenic fluids, Solids at cryogenic temperatures; Superconductivity, Recuperative - Linde - Hampson, Claude, Cascade, Heylandt, Kapitza, Collins, Simon; Regenerative - Stirling cycle and refrigerator, Slovay refrigerator, Gifford-McMahon refrigerator, Vuilleumier refrigerator, Pulse Tube refrigerator; Liquefaction of natural gas

Unit –III Cryogenic Insulation **9**

Vacuum insulation, Evacuated porous insulation, Gas filled Powders and fibrous materials, Solid foams, Multilayer insulation, Liquid and vapour Shields, Composite insulations

Unit –IV Storage and Instrumentation of Cryogenic Liquids **9**

Design considerations of storage vessel; Dewar vessels; Industrial storage vessels; Storage of cryogenic fluids in space; Transfer systems and Lines for cryogenic liquids; Cryogenic valves in transfer lines; Two phase flow in Transfer system; Cool-down of storage and transfer systems

CHAIRMAN - BOARD OF STUDIES

Unit –V Cryogenic Equipment **9**

Cryogenic heat exchangers - recuperative and regenerative; Variables affecting heat exchanger and system performance; Cryogenic compressors, Pumps, expanders; Turbo alternators; Effect of component inefficiencies; System Optimization and Magneto-caloric refrigerator

Total : 45 Periods

Text Books

1. T.M. Flynn, Marcel Dekker., Cryogenic Engineering, Springer Science, 1989.

Reference Books

1. Bose and P. Sengupta, "Cryogenics: Applications and Progress", Tata McGraw Hill, 1985.
2. J.G. Weisend II, Taylor and Francis , "Handbook of Cryogenic Engineering", CRC Press, 1998.

Additional / Web References

1. https://nptel.ac.in/downloads/112101004/
2. https://nptel.ac.in/Clarify_doubts.php?subjectId=112101004

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	2	1	-	2	-	1	-	3	2	3
CO 2	3	3	3	3	3	2	1	-	2	-	1	-	3	2	3
CO 3	3	3	3	3	3	2	1	-	2	-	1	-	3	2	3
CO 4	3	3	3	3	3	2	1	-	2	-	1	-	3	2	3
CO 5	3	3	3	3	3	2	1	-	2	-	1	-	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 (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				

CHAIRMAN - BOARD OF STUDIES

20AEE23	Heat Transfer	L	T	P	C
		3	0	0	3
Nature of Course	Programme Elective				
Pre requisites	Aero Thermodynamics				

Course Objectives

The course is intended to

1. To understand the mechanisms of heat transfer under steady and transient conditions.
2. To understand the concepts of heat transfer through extended surfaces.
3. To learn the thermal analysis and sizing of heat exchangers.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the difference between various modes of Heat Transfer and the Resistance Concept used in Heat Conduction.	Apply
CO2	Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems	Apply
CO3	Apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.	Apply
CO4	Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.	Apply
CO5	Learn to apply various technique used for high speed flow heat transfer.	Apply

Course contents:

Unit I Conduction **12**

General Differential equation of Heat Conduction - Cartesian and Cylindrical coordinates - One Dimensional Steady State Heat Conduction —- Plane and Composite Systems – Conduction with Internal Heat Generation – Heat transfer from Extended surface – Effect of Temperature on Conductivity - 1-D transient analysis.

Unit II Convection **10**

Forced convection – Laminar flow over flat plates and flow over Cylinders - flow across tube banks - Turbulent flow over flat plate and flow through pipes – Free Convection during external flow over Plates and Cylinders and Internal flow through tubes.

.

Unit III Heat Exchangers **10**

Heat Exchanger - Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method

CHAIRMAN - BOARD OF STUDIES

Unit IV Radiation **9**

Basic definitions – Concept of Black body - Laws of black body Radiation - Radiation between Black surfaces – Radiation Heat exchange between Grey surfaces – Radiation Shielding – Shape factor- Electrical network analogy in thermal radiation systems.

Unit V Heat Transfer Problems in Aerospace Engineering **4**

Heat transfer problems in gas turbines, Rocket thrust chambers - Aerodynamic heating – Ablative Heat transfer.

Total: 45 Periods

(Use of standard HMT data book permitted)

Text books:

1. Holman, J.P., "Heat Transfer", Tata McGraw Hill, Tenth Edition 2017.
2. R.C. Sachdeva, “Fundamentals of Engineering Heat & Mass transfer”, New Age International Publishers, Fourth Edition, 2017.
3. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, Fifth Edition, 2014.

References:

1. Nag, P.K., "Heat Transfer", Tata McGraw Hill, Third Edition New Delhi, 2011.
2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, Fourth Edition 2012.
3. Sutton,G.P., Rocket Propulsion Elements,John Wiley and Sons, Seventh Edition, 2001.
4. Lienhard,J.H., A Heat Transfer Text Book, Prentice Hall Inc., Fifth Edition 2000.

Data Book:

1. C P Kothandaraman, Heat and mass transfer data book, New Age International Publishers, Eighth Edition, 2014

E books:

http://web.mit.edu/lienhard/www/ahtt.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	3	2	-	-	-	-	2	2		2	2	-	-
CO2	3	3	3	2	-	-	-	-	2	2		2	2	-	-
CO3	3	3	3	2	3	-	-	-	2	2		2	2	-	-
CO4	3	3	3	2	-	-	-	-	2	2		2	2	-	-
CO5	2	2	3	2	-	-	-	-	1	1		2	2	-	-
	3	High				2	Medium					1	Low		

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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 – I	**IAE – II**	**IAE – III**	
Remember	10	10	10	20
Understand	40	40	20	60
Apply			20	20
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE24	Aircraft Cooling systems	L	T	P	C
		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Aircraft General Engineering and Maintenance Practices, Aero Engine Maintenance and Repair.				

Course Objectives

The course is intended to

1. Provide knowledge on the basics of refrigeration, unit of refrigeration, different thermodynamic cycles followed and conventional and unconventional refrigeration systems.
2. Understand classification of primary refrigerants, secondary refrigerants, their designations and their different properties. To make the students to learn different refrigerants available for refrigeration and air conditioning applications.
3. Learn different refrigeration equipment such as evaporator, compressor, condenser and expansion devices. To make the students to solve problems related to different conventional and unconventional refrigeration systems.
4. Knowledge on air water mixtures, empirical relations used to calculate desirable properties air water vapour mixture, different psychrometric properties and their use in air conditioning applications.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Illustrate the principles, nomenclature and applications of refrigeration systems.	Understand
CO 2	Explain vapor compression refrigeration system and identify methods for performance improvement	Understand
CO 3	Study the working principles of air, vapor absorption, thermoelectric and steam-jet and thermo-acoustic refrigeration systems	Understand
CO 4	Estimate the performance of air-conditioning systems using the principles of psychometry. Compute and Interpret cooling and heating loads in an air-conditioning system	Understand
CO 5	Identify suitable refrigerant for various refrigerating systems	Understand

Course Contents

Unit –I Introduction to Cooling Systems and Refrigeration **9**

Basic Definitions, Basic Air Cycle systems – Vapour Cycle Systems, Boot-strap air cycle system – Evaporative vapour cycle systems – Evaporation air cycle systems.Heat pump and Refrigerating Machine, Best Refrigeration Cycle: The Carnot Principle, Gas as a Refrigerant in Reversed Carnot Cycle, Limitations of Reversed Carnot Cycle, Reversed Brayton or Bell Coleman Cycle, Application to Aircraft Refrigeration, Simple Numerical problems.

Unit –II Vapor Compression Refrigeration System(VCRS) **9**

Modifications in Reversed Carnot Cycle with Vapor as a refrigerant, Vapor Compression Cycle, Ewing's Construction, Actual Vapor Compression Cycle, Effect of Operating Conditions. Simple Numerical problems. Multistage or Compound Compression, Multi-evaporator systems, Cascade Systems, – Methods like Flash Gas removal, Flash inter cooling and water Inter cooling.

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Unit –III Vapor Absorption Refrigeration Systems **9**

Simple Vapor – Absorption System, Maximum Coefficient of Performance of a Heat Operated Refrigerating Machine, Absorbent – Refrigerant combinations, Water-Ammonia Systems, Practical problems, Lithium- Bromide System, Modifications to Simple Vapor-Absorption, Electrolux Refrigerator. Steam-Jet refrigeration system, Thermoelectric refrigeration, pulse tube refrigeration, and thermo acoustic refrigeration systems

Unit –IV Refrigerants **9**

Primary and Secondary refrigerants, Designation of Refrigerants, Desirable properties of refrigerants, Selection of a Refrigerant, Ozone Depletion Potential and Global Warming Potential of CFC Refrigerants. Thermodynamic requirements, Comparison between different refrigerants, Substitutes for CFC refrigerants, Secondary Refrigerants. **Refrigeration systems Equipment:** Compressors, Condensers, Expansion Devices and Evaporators, A brief look at other components of the system.

Unit –V Air-Conditioning, Loading Calculation and Applied Psychometrics **9**

Basic Processes in Conditioning of Air, Psychrometric Processes in Air-Conditioning Equipment, Simple Air-Conditioning /system and State and Mass Rate of Supply Air, Summer Air Conditioning, Winter Air Conditioning. Preliminary Considerations, Internal Hear Gains, System Heat Gains, Break-up of Ventilation Load and Effective Sensible Heat Factor, Cooling Load Estimate. Psychrometric Calculations for Cooling, Selection of Air-Conditioning Apparatus for Cooling and Dehumidification, Building Requirements and Energy Conservation in Air Conditioned Buildings.

Total : 45 Periods

Text Books

1. Roy J. Dossat, Principles of Refrigeration, Wiley Limited
2. Arora C.P., Refrigeration and Air-conditioning, Tata Mc Graw –Hill, New Delhi, 2ndEdition, 2001.
3. Stoecker W.F., and Jones J.W., Refrigeration and Air-conditioning, Mc Graw - Hill, New Delhi 2nd edition, 1982.

Reference Books

1. Dossat, Principles of Refrigeration Pearson-2006.
2. Mc Quistion, Heating, Ventilation and Air Conditioning, Wiley Students edition, 5th edition 2000.
8. PITA, Air conditioning 4th edition, pearson-2005
9. Refrigeration and Air-Conditioning' by Manohar prasad
10. S C Arora& S Domkundwar, Refrigeration and Air-Conditioning Dhanpat Rai Publication

Additional / Web References

1. http://nptel.ac.in/courses/112105128/#

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**		

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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	40	80
Apply				
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE25	Combustor Modelling	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Propulsion				

Course Objectives

The course is intended to

1. Familiarize in Diffusion Flames and Droplet Burning
2. Knowledge in combustion of solid propellants
3. Create confidence to ignition, extinction, flammability limits and
4. Enable the students to understand the spray combustion

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the concept diffusion and droplet burning	Understand
CO2	Remember the concepts of solid propellants	Remember
CO3	Apply the limit of ignition and flammability	Remember
CO4	Remember combustion instabilities	Remember
CO5	Understand the spray combustion	Understand

Course Contents:

Unit I Diffusion Flames and Droplet Burning **9**

The flame at the mouth of a tube in a duct- Definition, Assumptions, species conservation equation The flame shape and the flame height, formulation and the analysis -The oxidation of carbon at the walls of a duct- Definition, nature of carbon combustion, Analysis- The burning of a fuel particle in an oxidizing atmosphere- definition, Assumptions, Analysis predicting the burning rate,simple problems -Structure of the flame - Monopropellant droplet burning

Unit II combustion of Solid Propellants **9**

Description of steady deflagration of a homogeneous solid- Applications of transition-state theory Approach to interfacial equilibrium -Deflagration controlled by condensed-phase reaction rates - Deflagration controlled by gas-phase reaction rates -Dispersion phenomena and other influences - Combustion of heterogeneous propellants -Erosive burning

.

Unit III Ignition, Extinction, and Flammability Limits **9**

Minimum ignition energies and quenching distances- Premixed flames with heat losses - Methods of analysis, The existence of two flame speeds, Concentration limits of flammability, Pressure limits of flammability,Estimates of heat loss -Activation-energy asymptotic in ignition theory

Unit IV Combustion Instabilities **9**

Acoustic instabilities in solid-propellant rocket motors -Oscillation modes, Conservation of acoustic energy,The acoustic admittance, Damping mechanisms, Amplification mechanisms, Nonlinear effects-

Inherent oscillations of burning solids-Oscillatory burning in liquid-propellant rocket motors-. System instabilities in combustion equipment-Hydrodynamic and diffusive instabilities in premixed flames

Unit V Spray Combustion **9**

Spray statistics-Simplified model of combustion in a liquid-propellantrocket motor-The conservation equations for dilute sprays- Simplified conservation equations- Extended model of combustion in a liquid-propellantrocket motor-Deflagrations in sprays- . Spray penetration and cloud combustion

Total: 45 Periods

Text Books:

1. F.A Williams, “Combustion theory”, Benjamin cummins,1985

Reference Books:

1. N.Peters, “Turbulent Combustion”, Cambridge University Press, 2005.
2. R.S cant &E.Mastorakos “An introduction to turbulent reacting flows”, Imperial college press,2008.

Additional References:

1. https://nptel.ac.in/courses/112/104/112104272/

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	2	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	1	2	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	1	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’sLevel	**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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE26	Micro Propulsion System	L	T	P	C
		3	0	0	3
Nature of Course	Professional Electives				
Pre requisites	Aerospace Propulsion				

Course Objectives:

The course is intended to

1. To learn about the types of micro propulsion system
2. To understand the emerging technologies of micro propulsion system
3. To gain knowledge on MEMS systems
4. To render information about system considerations of micro propulsion system
5. To learn more ways of experiments in micro propulsion system

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understanding the types of micro propulsion	Understand
CO2	Learning the emerging technologies of micro propulsion	Apply
CO3	Gaining knowledge on MEMS system	Apply
CO4	Considering the system requirements for micro propulsion system	Understand
CO5	Learn to do more experiments on micro propulsion system	Understand

Course Contents:

UNIT I Introduction and types of Micro propulsion **9**

Introduction - Chemical Micro Propulsion – Electromagnetic Micro Propulsion – Electrostatic Micro Propulsion – Electro dynamic Tether – Electric Power Processing

UNIT II Emerging Technologies **9**

Recent trends – System integration requirements – minimum pulse bit and thrust requirements – Bipropellant engines – Monopropellant engines – Monopropellant thrusters – Cold Gas thrusters – sold and hybrid rocket motors

UNIT III MEMS **9**

Propulsion Concepts - Case for MEMS Propulsion and Its Challenges - Brief History of MEMS Propulsion - Micro-Ion Engine Concepts - MEMS-Based Microresistojet Concepts – Subliming Solid Microthruster Concept - Cold Gas Thruster Concept - Bipropellant Thruster Concept

UNIT IV System Considerations **9**

Micro spacecraft – Micro propulsion – Micro propulsion Scaling Issues – Micro nozzle Expansions - Ion Formation at Small-Scale Lengths - Micron-Scale Combustion and Mixing - Micro-Heat Transfer

UNIT V Experiments **9**

Nomenclature – Propellant testing – Electron Temperature experiment – Doppler shift experiment – Thrust measurement

Total: 45 Periods

CHAIRMAN - BOARD OF STUDIES

Text books:

1. Michael M. Micci, Andrew D. Ketsdever , “Micropropulsion for small Spacecraft”, American Institute of Aeronautics and Astronautics, 2000.

References:

1. Martin Tajmar, “Advanced Space propulsion system”, Springer, 2003

Additional/ Web Resources:

1. https://youtu.be/zP72l08yD3Q

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	3	3	2	-	-	2	-	2	-	3	2	3
CO2	3	3	3	3	3	2	-	-	2	-	2	-	3	2	3
CO3	3	3	3	3	3	2	-	-	2	-	2	-	3	2	3
CO4	3	3	3	3	3	2	-	-	2	-	2	-	3	2	3
CO5	3	3	3	3	3	2	-	-	2	-	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 (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE27	Aero Engine Control System	L	T	P	C
		3	0	0	3
Nature of Course	Professional Electives				
Pre requisites	Aircraft Systems and Instruments				

Course Objectives

The course is intended to

1. To know about the engine control and system history
2. To know about the engine monitoring and simulation
3. To learn the design aspects on set-point controllers and design
4. To implement on control mode and engine accessories
5. To monitor the engine and its health management through various designs

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Know about the engine control system history	Understand
CO2	Gaining knowledge on engine modeling and simulation	Apply
CO3	Learn about the design of set-point controllers	Apply
CO4	Implement the control system integration on aircraft engines	Apply
CO5	Concentrating on monitoring and health management	Understand

Course contents:

UNIT I Overview of Engine Control Systems **9**

Terminology for Control Systems - Introduction to Gas Turbine Engine Control Systems - Historical Development of Engine Control Systems

UNIT II Engine Modelling and Simulation **9**

Steady-State Engine Models - Dynamic Engine Models - Modelling of Complete Engine Dynamics - Modelling of Actuator and Sensor Dynamics - High-Fidelity Engine Simulations - Derivation of Linear Engine Models

UNIT III Design of Set-Point Controllers **9**

Controller Design for One-Spool Engines - Controller Design for Two-Spool Engines - Control Design for Turboshaft Engines - Some Practical Considerations for Set-Point Controls

UNIT IV Control System Integration **9**

Power Setting - Transient Schedules - Control Modes - Engine Accessories - Controller Synthesis Examples

UNIT V Engine Monitoring and Health Management **9**

Basic Concepts - Monitoring System Design - Monitoring Algorithm Design - Trend Monitoring from Periodically Recorded Data - Integration Architecture, Capabilities and Requirements - Life-Extending Control - Safety Assurance Control

Total: 45periods

CHAIRMAN - BOARD OF STUDIES

Text Books:

1. Link C. Jaw, Jack D. Mattingly, "Aircraft Engine controls design, system analysis and health monitoring" AIAA Education series, 2009.

References:

1. K.Padmanabhan, "Control Systems" Dreamtech press, 2020.

Additional References:

1. https://www.rolls-royce.com/media/press-releases-archive/yr-2012/120608-engine-controls.aspx

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	1	2	1	-	2	-	-	-	3	2	3
CO2	3	3	3	2	1	2	1	-	2	-	-	-	3	2	3
CO3	3	3	3	2	1	2	1	-	2	-	-	-	3	2	3
CO4	3	3	3	2	1	2	1	-	2	-	-	-	3	2	3
CO5	3	3	3	2	1	2	1	-	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 (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE28	Rockets and Missiles	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Propulsion and Aerodynamics				

Course Objectives:

The course is intended to

1. To know types of rockets and missiles with respect to Indian & international scenario.
2. Enrich their knowledge in the area of missile and rocket flight.
3. Understand space and gravity.
4. To know the staging of rockets.
5. To select materials for the rockets.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Outline diverse varieties of rockets and missiles.	Understand
CO2	Understanding aerodynamics of rocket and missiles.	Understand
CO3	Analyze the motion of rockets.	Analyze
CO4	Explain the various types of stages and control of rockets & missiles.	Understand
CO5	Inspect a range of control methods of rockets and launch vehicles.	Understand

Course Contents:

UNIT I Classification of Rockets and Missiles **9**

Various methods of classification of missiles and rockets – Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles – Examples of various Indian space launch vehicles and missiles.

UNIT II Aerodynamics of Rockets and Missiles **9**

Airframe components of rockets and missiles – forces acting on a missile while passing through atmosphere – classification of missiles – slender body aerodynamics – method of describing forces and moments – lift force and lateral moment –lateral aerodynamic damping moment – longitudinal moment – drag estimation – up wash and downwash in missile bodies – rocket dispersion.

UNIT III Rocket Motion in Free Space and Gravitational Field **9**

One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields – description of vertical, inclined and gravity turn trajectories – determination of range and altitude – simple approximations to determine burn out velocity and altitude – estimation of culmination time and altitude.

UNIT IV Staging of Rockets and Missiles **9**

Design philosophy behind multistage of launch vehicles– multistage vehicle optimization– stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics.

CHAIRMAN - BOARD OF STUDIES

UNIT V Control of Rockets and Launch Vehicles **9**

Introduction to aerodynamic control and jet control methods- thrust control methods – various types of thrust vector control methods including secondary injection thrust vector control for launch vehicles.

Total: 45 Periods

Text books:

1. Cornelisse, J.W., “Rocket Propulsion and Space Dynamics”, J.W. Freeman & Co.,Ltd, London, 1982.
2. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons; 8th Edition 2010.

References:

1. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 2nd edition 2014.
2. Parket, E.R., “Materials for Missiles and Spacecraft”, McGraw-Hill Book Co. Inc., 1982.

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	2	3	2	2	1	-	1	-	-	-	2	2	3	2	1
CO2	3	2	2	2	-	-	1	-	-	1	2	1	3	3	1
CO3	1	2	2	2	-	-	-	-	-	-	2	1	3	2	1
CO4	2	2	2	2	-	-	-	-	-	-	2	1	3	3	1
CO5	3	2	2	2	1	-	-	-	-	1	2	2	3	3	1
	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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE29	HIGH TEMPERATURE GAS DYNAMICS	L	T	P	C
		3	0	0	3
Nature of course	Programme Elective				
Pre requisites	Thermodynamics				

Course Objectives

The course is intended to

1. To provide the student with fundamental knowledge and understanding in High Temperature Gas Dynamics.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Acquire knowledge on high temperature flows and the associated gas equations and functions.	Understand
CO 2	Apply the basics of statistical thermodynamics to calculate the thermodynamic properties of gas species.	Understand
CO 3	Acquire knowledge of the governing equations of inviscid high temperature equilibrium and non-equilibrium flows	Understand
CO 4	Distinguish the mechanism of thermal conduction and diffusion and calculate transport properties.	Understand
CO 5	Acquire knowledge of the governing equations of viscous chemically reacting flows and apply parabolized Navier-Stokes equations for chemically reacting flows.	Understand

Course Contents

Unit –I Introduction **8**

Importance of High-Temperature Flows, Nature of High-Temperature Flows, Chemical Effects in Air:The Velocity-Altitude Map, Thermodynamics of Chemically Reacting Gases, Kinetic theory of gases, Definition of Real Gases and Perfect Gases, Various Forms of the Perfect-Gas Equation of State, Collision Frequency and Mean Free Path, Velocity and Speed Distribution Functions, Classification of Gases, First Law of Thermodynamics, Second Law of Thermodynamics, Calculation of Entropy, Gibbs Free Energy, Heat of Reaction

Unit –II Statistical Thermodynamics **10**

Introduction, Microstates & Macrostates, Boltzmann Distribution, Evaluation of Thermodynamic Properties in Terms of the Partition Function, Evaluation of the Partition Function in terms of T and V, Thermodynamic Properties for a Single Chemical Species, Calculation of the Equilibrium Constant, Chemical Equilibrium, Calculation of the Equilibrium Composition or High-Temperature Air, Thermodynamic Properties of an Equilibrium Chemically Reacting Gas, Equilibrium Properties of High-Temperature Air.

UNIT –III Inviscid High Temperature Equilibrium And Non Equilibrium Flows **10**

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Introduction, Governing Equations for Inviscid High-Temperature Equilibrium Flow, Equilibrium Normal and Oblique Shock-Wave Flows, Equilibrium Quasi-One-Dimensional Nozzle Flows, Frozen and Equilibrium Flows:The Distinction, Equilibrium and Frozen Specific Heats, Equilibrium Speed of Sound, Equilibrium Conical Flow,Equilibrium Blunt-Body Flows. Governing Equations for Inviscid, non-equilibrium flows, Non-equilibrium Normal and Oblique Shock-Wave Flows.

UNIT-IV Transport Properties In High Temperature Gases **8**

Introduction, Definition of Transport Phenomena, Transport Coefficients, Mechanism of Diffusion, Energy Transport by Thermal Conduction and Diffusion: Total Thermal Conductivity, Transport Properties for High-Temperature Air.

UNIT –V Viscous High Temperature Flows **9**

Introduction, Governing Equations for Chemically Reacting Viscous Flow, Alternate Forms of the Energy Equation, Boundary-Layer Equations for a Chemically Reacting Gas, Boundary Conditions: Catalytic Walls, Boundary-Layer Solutions: Stagnation-Point Heat Transfer for a Dissociating Gas, Parabolized Navier-Stokes Solutions to Chemically Reacting Flows

Total : 45 Periods

Text Books

1. John D. Anderson Jr., “Hypersonic and High-Temperature Gas Dynamics”, 2nd Edition, AIAA Education Series, 2006.

Reference Books

1. Tarit K. Bose, “High Temperature Gas Dynamics”, 2nd Edition, Springer, 2014.
2. H.W. Liepmann and A Roshko, “Elements of Gas Dynamics”, Dover Publications, 2001
3. John D. Anderson, “Modern Compressible Flow: with Historical Perspective”, McGraw Hill Education, Indian Edition, 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**	**3**
CO 1	2	3	2										2	2	2
CO 2	2	3	2										2	2	2
CO 3	2	3	2										2	2	2
CO 4	2	3	2										2	2	2
CO 5	2	3	2										2	2	2
	3	**High**				**2**	**Medium**					**1**	**Low**		

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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				

CHAIRMAN - BOARD OF STUDIES

20AEE13	Wind Tunnel Techniques	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Aerodynamics				

Course Objectives

The course is intended to

1. To understand the different types of wind tunnels.
2. To interpret the basic concepts of measuring setup of forces and moments on models during the wind tunnel testing.
3. To understand the application of various types of wind tunnels.
4. To learn the basic measurement procedure involving wind tunnel testing.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Analyze the dimension of physical quantities using different methods.	Understand
CO2	Design and analyze different types of wind tunnel with respect to speed regions.	Understand
CO3	Apply the calibration procedure in wind tunnel based on speed, flow angularity and turbulence.	Understand
CO4	Compare the wind tunnel measurement techniques and their applications and limitations.	Understand
CO5	Check the flow around aerodynamic models using flow visualizations techniques.	Understand

Course Contents:

Unit I Introduction **9**

General features -Types of wind tunnel, Low speed wind tunnel - High speed wind tunnel - Effuser - diffuser-test section - driving unit - special purpose tunnels.

Unit II Low Speed Wind Tunnels **9**

Components of low speed wind tunnel - convergent section - test section - divergent section – power plant- power losses - energy ratio - losses in cylindrical section -losses in convergent cone - honeycombs -guide vanes-losses due to open jet test section.

Unit III High Speed Wind Tunnel **9**

Blow down type wind tunnels - Induction type tunnels - continuous supersonic wind tunnels - losses in supersonic wind tunnel - supersonic wind tunnel diffusers - effect of second throat.

Unit IV Wind Tunnel Measuring Setup **9**

Pressure and velocity measurements - force measurements - three component and six component balances- internal balances.

Unit V Flow Visualization **9**

Smoke and tuft grid techniques - Water flow visualization method - dye injection special techniques

Total: 45 Periods

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Text Books:

1. Rae, W.H. and Pope, A. "Low Speed Wind Tunnel Testing", John Wiley Publication, 1984.
2. Robert B Northrop, "Introduction to Instrumentation and Measurements", Second Edition, CRC
3. Press, Taylor & Francis, 2006.

Reference Books:

1. Antonio Viviani, Giuseppe Pezzella, "Aerodynamic and Aerothermodynamic Analysis of Space
2. Mission Vehicles", Springer Aerospace Technology, 2015.
3. Pavian, Henry Christensen, "Experimental Aerodynamics", 1st edition, Pitman Publishing, 1940.
4. G P Russo, "Aerodynamic Measurements: From Physical Principles to Turnkey Instrumentation",
5. Woodhead publishing, 1990.
6. Rathakrishnan, E., "Instrumentation, Measurements, and Experiments in Fluids", CRC Press -
7. Taylor & Francis, 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	3	2	2	2	-	-	-	-	-	1	2	3	2	3
CO2	2	3	2	2	2	-	-	-	-	-	1	2	3	2	3
CO3	3	3	2	2	2	-	-	-	-	-	1	2	2	2	3
CO4	2	2	2	2	2	-	-	-	-	-	-	2	2	2	3
CO5	3	2	3	2	2	-	-	-	-	-	1	2	2	2	3
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom'sLevel	**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				

20AEE31		**L**	**T**	**P**	**C**

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		3	**0**	**0**	**3**

Nature of Course	Professional Elective
Pre requisites	Aerodynamics, Propulsion

Course Objectives

The course is intended to

1. To introduce different co-ordinate transformation techniques and basic missile equations of motion.
2. To introduce types of missile airframes and autopilots.
3. To introduce different missile guidance and control techniques.
4. To introduce to weapon delivery system and the problems involved in it.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Explain the history of missiles and systems.	Understand
CO2	Ability to identify the fundamentals for missile airframe and control.	Apply
CO3	Explore the missile guidance laws	Apply
CO4	Ability to solve the problems in missile control technology	Apply
CO5	Exposure on various weapon delivery systems.	Understand

Course contents:

UNIT I Missile Systems Introduction **8**

History of guided missile for defense applications- Classification of missiles– The Generalized Missile Equations of Motion- Coordinate Systems- Lagrange‘s Equations for Rotating Coordinate Systems- Rigid-Body Equations of Motion-missile system elements, missile ground systems

UNIT II Missile Airframes, Autopilots and Control **9**

Missile aerodynamics- Force Equations, Moment Equations, Phases of missile flight. Missile control configurations. Missile Mathematical Model. Autopilots — Definitions, Types of Autopilots, Example Applications. Open-loop autopilots. Inertial instruments and feedback. Autopilot response, stability, and agility- Pitch Autopilot Design, Pitch-Yaw-Roll Autopilot Design.

UNIT III Missile Guidance Laws **10**

Tactical Guidance Intercept Techniques, Derivation of the Fundamental Guidance Equations, explicit, Proportional Navigation, Augmented Proportional Navigation, beam riding, bank to turn missile guidance, Three-Dimensional Proportional Navigation, comparison of guidance system performance, Application of Optimal Control of Linear Feedback Systems.

UNIT IV Strategic Missiles **10**

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Introduction, The Two-Body Problem, Lambert's Theorem, First-Order Motion of a Ballistic Missile Correlated Velocity and Velocity-to-Be-Gained Concepts, Derivation of the Force Equation for Ballistic Missiles, Atmospheric Reentry, Ballistic Missile Intercept, Missile Tracking Equations of Motion, Introduction to Cruise Missiles , The Terrain-Contour Matching (TERCOM) Concept..

UNIT V Weapon Delivery Systems **8**

Weapon Delivery Requirements, Factors Influencing Weapon Delivery Accuracy, Unguided Weapons, The Bombing Problem, Guided Weapons, Integrated Flight Control in Weapon elivery, Missile Launch Envelope, Mathematical Considerations Pertaining to the Accuracy of Weapon Delivery Computations.

Total: 45 Periods

Text books:

1. Siouris, G.M. "Missile Guidance and control systems", Springer, 2003.
2. Blakelock, J. H.; Automatic Control of Aircraft and Missiles, 2nd Edition, JohnWiley& Sons, 1990.

References:

1. Fleeman, Eugene L.; Tactical Missile Design, First Edition, AIAA Educationseries, 2001.
2. Garnell, P., "Guided Weapon Control Systems", 2nd Edition, Pergamon Press,1980

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	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	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**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20AEE32	**High Temperature Materials**	**L**	**T**	**P**	**C**

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		3	**0**	**0**	**3**
Nature of Course	Professional Elective				
Pre requisites	Engineering materials and metallurgy				

Course Objectives

The course is intended to

1. Familiarize creep behavior of viscous effect
2. Determining the rupture life of a component
3. Enable the various types of fracture and its occurrence
4. Create confidence to remember corrosion and oxidations
5. Analysis the material behavior

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the creep behavior, mechanisms and effect of stress, temporary, strain rate on creep.	Understand
CO2	Remember the laws that would be beneficial in determining the rupture life of a component	Remember
CO3	Understand of various types of fracture and its occurrence	Understand
CO4	Knowledge of Oxidation and Corrosion, its interaction, transition and methods to combat hot corrosion.	Understand
CO5	Explain the super alloys and other high temperature materials.	Understand

Course Contents:

Unit I Creep **9**

Creep – Creep Strength, Creep Limit, Creep Curve - Stages of Creep, Creep Fracture, FactorsInfluencing creep property of a material, Factors Affecting Creep – Temperature, Stress, Time, Grain Size, Mechanism of Creep – Diffusion Creep & Dislocation Creep, Metallurgical FactorsInfluencing Creep at High Temperature, Creep Test, Creep resistant materials

Unit II Laws to Determine Creep **9**

Laws of Creep- Andrade's law, Logarithmic Law, Hyperbolic Law of Transient creep, Secondary Creeplaw, Laws to determine rupture life of component – Larson –Miller Parameter, Monkman Grant Relationship, Creep Mechanism Maps.

Unit III High Temperature Fracture **9**

Fracture – Types of Fracture –Ductile fracture, Brittle fracture, Shearing Fracture, Factors AffectingFracture, Fracture toughness, Griffith Theory of Brittle Fracture, Blue Brittleness, Orange Peel Effect, Cleavage Fracture, Micro void Coalescence and Dominant Void Growth Modes, Ductile to Brittle Transition (DBT), Bauchinger's effect.

Unit IV Oxidation & Corrosion **9**

Oxidation –Nature of Oxides formed on Metal Surface, Types of Corrosion, Kinetic laws of Oxidation – Parabolic rate law, Linear rate law and Logarithmic rate law, Pilling-Bedworth ratio, Corrosion – Types of Corrosion, Factors Influencing Corrosion, Fluxing Mechanisms – Acidic and Basic Fluxing, Effect of Alloying Element on Hot Corrosion, Corrosion Control - Methods to Combat Hot Corrosion.

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Unit V High Temperature Resistant Materials **9**

Super Alloys – Cobalt Base, Nickel base, Iron Base. Ultra High Temperature Ceramics, Intermetallic, Thermal Barrier Coatings, Hydrogen Embrittlement, Refractory Metals, Structural Heat Resistant Composites.

Total: 45 Periods

Text Books:

1. Norman E Dowling, “Mechanical Behaviour of Materials” Pearson Publisher, Fourth Edition, 2012.
2. Jun-Shan Zhang, “High Temperature Deformation and Fracture of Materials”, First Edition, Woodhead Publishing, 2010.

Reference Books:

1. J.Betten, “Creep Mechanics” Springer, 3rd Edition 2008

Additional References:

2. https://books.google.co.in/books?id=e-51AgAAQBAJ&printsec=frontcover#v=onepage&q&f=fale
3. https://www.crcpress.com/High-Temperature-Materials-and-Mechanisms/Bar-Cohen/p/book/978 1138071544

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	2	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	1	1	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	1	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’sLevel	**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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

STREAM – 3 AIRCRAFT STRUCTURE AND DESIGN

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20AEE41	Optimization and its applications	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	NIL				

Course objectives:

The course is intended to

1. To explain the theory of optimization methods and algorithms developed for solving various types of optimization problems.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Apply basic theoretical principles in optimization and formulate the optimization models	Apply
CO 2	Understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function.	Understand
CO 3	Solve the constraints for optimal solution to interface in industrial scenario	Apply
CO 4	Implement optimization techniques in engineering problems.	Apply
CO 5	Apply dynamic programming to optimize multi stage decision problems	Apply

Course Contents

Unit I Evoulutionof Optimisation **9**

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems. Genetic algorithms – Simulated annealing – Neural Network, Fuzzy systems and Particle swam optimization

Unit II Classic Optimization Techniques **9**

Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming.

Unit III Non-Linear Programming **9**

Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming

Unit IV Static Applications **9**

Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members – Design of springs.

Unit V Dynamic Applications **9**

Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

Total: 45 Periods

Text Book

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1. Sukanta Nayak “Fundamentals of Optimization Techniques with Algorithms”, Elsevier Science ,2020
2. Rao S. S. – ‘Engineering Optimization, Theory and Practice’ – New Age International Publishers – 2012 – 4th Edition

Reference books:

1. R. Panneerselvam, “Operations Research”, Prentice Hall of India Private Limited, New Delhi L, 2005
2. P.K. Guptha and Man-Mohan, “Problems in Operations Research” – Sultan Chand & Sons, 1994
3. Ravindran, Philips and Solberg, “Operations Research Principles and Practice”, John Wiley & Sons, Singapore, 1992
4. J.K.Sharma, “Operations Research – Theory and Applications” – Macmillan India Ltd., 1997

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	1	-	1	2	-	-	-	-	-	-	2	2	-	-
CO2	3	1	-	1	2	-	-	-	-	-	-	2	2	-	-
CO3	3	1	-	1	2	-	-	-	-	-	-	2	2	-	-
CO4	3	1	-	1	2	-	-	-	-	-	-	2	2	-	-
CO5	3	1	-	1	2	-	-	-	-	-	-	2	2	-	-
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom’sLevel	**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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

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20AEE42	Fatigue and fracture	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	**Aircraft Structures**				

Course objectives:

The course is intended to

1. To understand the basic concepts involved in fatigue analysis and to study the importance of fracture mechanics in aerospace applications.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Solve and estimate fatigue life for simple problems	Apply
CO 2	Understand and solve the concepts of cumulative damage and load histories.	Understand
CO 3	Estimate fatigue crack propagation life for simple problems	Apply
CO 4	Apply the concept fracture mechanics to aircraft structure problems	Apply
CO 5	Expose to the concept of various design philosophies, fatigue resistance of fiber-metal laminates	Apply

Course Contents

Unit I Fatigue of Structures **7**

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber‟s stress concentration factors - Plastic stress concentration factors - Notched S.N. curves – Fatigue of composite materials.

Unit II Statistical Aspects of Fatigue Behaviour **10**

Low cycle and high cycle fatigue - Coffin - Manson‟s relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage - Miner‟s theory - Other theories.

Unit III Physical Aspects of Fatigue **10**

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.

Unit IV Fracture Mechanics **10**

Strength of cracked bodies - Potential energy and surface energy - Griffith‟s theory - Irwin - Orwin extension of Griffith‟s theory to ductile materials - stress analysis of “cracked bodies - Effect of thickness on fracture toughness” - stress intensity factors for typical „geometries.

Unit V Fatigue Design and Testing **8**

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

Total: 45 Periods

Text books:

1. Prasanth Kumar, "Elements of fracture mechanics", Wheeter publication, 2009.
2. Barrois W, Ripely, E.L., “Fatigue of aircraft structure," Pergamon press. Oxford, 1983.

References:

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1. Sih C.G., “Mechanics of fracture.” Vol - I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
2. Knott, J.F., “Fundamentals of Fracture Mechanics,” - Buterworth & Co., Ltd., London, 1983.
3. Robert o Ritchie ,"Introduction to Fracture Mechanics", elseiver,2021

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	1	1	2	-	-	-	-	-	-	2	2	-	-
CO2	3	3	1	1	2	-	-	-	-	-	-	2	2	-	-
CO3	3	3	1	1	2	-	-	-	-	-	-	2	2	-	-
CO4	3	3	1	1	2	-	-	-	-	-	-	2	2	-	-
CO5	3	3	1	1	2	-	-	-	-	-	-	2	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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

20AEE43	**Failure analysis**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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Nature of Course	Professional Elective
Pre requisites	nil

Course objectives:

The course is intended to

1. To introduce students with various fracture phenomenons and their analysis using different techniques.
2. To acquire basic understanding of failure analysis.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	To understand the principles of failure analysis and examination of failed components.	understand
CO 2	Predict the Environment Induced Failures	Apply
CO 3	To identify the wear related failures in components.	Apply
CO 4	Apply statistical tools in quality control and solve related numerical problems.	Apply
CO 5	Select tools for failure analysis and perform case studies	Apply

Course Contents

UNIT-1 Introduction **9**

Definition of failures, Classification of failures, Instantaneous failures, Cumulative failures, Fundamental causes of failures-Deficiencies in design, Deficiencies in selection of materials, Imperfection in materials. Principles and Approaches of Failure analysis, objectives, scope, planning, preparation, Failure Analysis procedures, examination of damages and materials evaluation .

UNIT-II Environment Induced Failures **9**

Corrosion damage, Forms of corrosion-Uniform attack, Two metal corrosion or galvanic corrosion, Crevice corrosion, Pitting corrosion, Inter-granular corrosion, Selective leaching, Erosion corrosion, Corrosion cracking- Stress Corrosion Cracking, Corrosion fatigue, Hydrogen cracking, Hydrogen degradation, Liquid metal embrittlement, High temperature corrosion, corrosion failure mechanisms and Preventive techniques.

UNIT-III Wear Failures **9**

Definition of wear, Types of wear-adhesive wear, Abrasive wear, Corrosive wear, Erosive wear, fretting wear, Fatigue wear, Wear failure mechanisms and Preventive techniques Failure of fraction surfaces Failure of seals, Creep failures, Stages of creep, Creep curve, Stress rupture.

UNIT-IV Failure Data Analysis **9**

MTTF, MTBF, Bath tub Curve, Mean Life, Life Testing, Problems, Introduction to Failure Mode and Effect Analysis

UNIT-V Tools for failure analysis: **9**

CHAIRMAN - BOARD OF STUDIES

Microscopic examination-Metallurgical Microscope, Electron Microscope, Fatigue test, Non-Destructive Testing techniques-Magnetic particle inspection, Radiography, Liquid penetrant inspection, Eddy current testing, Ultrasonic testing, Acoustic Emission Testing, Thermography, Chemical analysis- Spectroscopy.

Total: 45 Periods

Text Book:

1. Failure Analysis & Prevention American Society of Metal Handbook V 10.11 and 17.
2. H.M. Tawancy, A. Ul-Hamid and N.M. Abbas, Marcel Dekker “Practical engineering failure analysis” New York, 2004.
3. Failure analysis and prevention, Volume 11, ASM Handbook, The Materials Information Society, 2002.
4. V. amachandran, A.C. Raghuram, R.V. Krishnan and S.K. Bhaumik “Failure analysis of engineering structures” Methodology and case histories, ASM International, 2005

Reference Books:

1. V. Ramachandran, A.C. Raghuram, R.V. Krishnan, and S.K. Bhaumik, “Failure analysis of engineering structures: Methodology and case histories” ASM International, 2005
2. A.J. McEvily, J. Kasivitamnuay, “Metal Failures: Mechanisms, Analysis, Prevention, Wiley”Interscience, 2013.
3. C. R. Brooks and A. Choudhury, “Failure analysis of engineering materials” McGraw-Hill.2002

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	1	1	1	-	-	-	-	-	-	2	2	1	-
CO2	3	2	1	1	1	-	-	-	-	-	-	2	2	1	-
CO3	3	2	1	1	1	-	-	-	-	-	-	2	2	1	-
CO4	3	2	1	1	1	-	-	-	-	-	-	1	2	1	-
CO5	3	2	1	1	1	-	-	-	-	-	-	1	1	1	-
	3	High				2	Medium				1	Low			

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

Summative Assessment

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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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

		3	**0**	**0**	**3**
Nature of Course	Professional Elective				
Pre requisites	Aircraft Structural Analysis				

Course Objectives

The course is intended

1. To study the various aircraft structural Testing methods.
2. To understand the theory of aircraft structural Testing methods.
3. To study the Industrial Applications of aircraft structural Testing methods.
4. To study the different methods of NDT
5. To study the Concept of Liquid penetrant and Magnetic Particle Inspection

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Understand the role of structural testing application and procedures for aircraftstructures.	Understand
CO 2	Identify the appropriate test method for the load applied on an aircraft	Apply
CO 3	Determine Industrial Applications of aircraft structural Testing methods.	Apply
CO 4	Determine the different methods of NDT	Understand
CO 5	Understandthe Concept of Liquid penetrant and Magnetic Particle Inspection.	Understand

Course Contents:

UNIT I Introduction **9**

Certification for testing Civil & Military aircraft, FAR and MIL Standard Aircraft testing,- Threats to Structural Integrity and the Role & Scope of Testing and Analysis - Experimental Characterization of Composites Used in Aerospace Applications

UNIT II DataGeneration **9**

Datageneration & Development Tests for Aircraft Structural Joints & Features - StructuralTesting for Crashworthiness and Impact.

UNIT III Aircraft Testing Methods **9**

Strain Gauging & Measurement of Structural Loads on Aircraft & Components- FullScale Static & Fatigue Testing of Aircraft Structures & Components–Understandingaircraft structural dynamics & development of associated test requirements

UNIT IV AircraftVibration Testing **9**

Role-Scope-Methodology & Facilities-Structural Testing of Civil Aircraft Instrumentation-data acquisition & test controls in aircraft structural testing

UNIT V Non Destructive Testing **9**

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results -Magnetic Particle

Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

Total 45 Periods

Text books

1. Full-Scale Structural Testing, John E. McCarty, ASM International, Volume 21, doi: doi.org/10.31399/asm.hb.v21.9781627081955, 2001.
2. Handbook on structural testing Robert T. Reese, Wendell A. Kawahara,Fairmont Press, 1999.

References

1. MIL-STD-1540D report.
2. FAA-AC- 23-19A report.
3. Introduction of Nondestructive testing - A training guide, John Wiley & Sons

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	-	3	-	-	-	-	-	2	-	-	-	2	-	-
CO4	3	-	3	-	-	-	-	-	2	-	-	-	2	-	-
CO5	3	-	3	-	-	-	-	-	2	-	-	-	2	-	-
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom'sLevel	**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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

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20AEE45	Experimental Technology for Aircraft Structures	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Experimental Stress Analysis				

Course Objectives

The course is intended

1. To study the role of Stress Strain and Displacement Fields.
2. To understand the theory of aircraft structural Testing methods.
3. To study the Concept of Photo Elastic Coating.
4. To study the different methods of Stress Analysis
5. To study the Concept of ofSoldering, Accounting for Transverse Sensitivity Effect

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Understand the role of Stress Strain and Displacement Fields	Understand
CO 2	Identify the appropriate test method for the load applied on an aircraft	Apply
CO 3	Understand the Concept of Photo Elastic Coating.	Apply
CO 4	Determine the different methods of Stress Analysis	Understand
CO 5	Understandthe Concept of Soldering, Accounting for Transverse Sensitivity Effect	Understand

Course Contents:

UNIT I Stress, Strain andDisplacement Fields **9**

Stress, Strain and Displacement fields for variousproblems -Beam under pure bending,-Analyticalsolution -Fringe contours from various experimental methods -Disc under diametral compression -Analytical solution - Fringe contours from variousexperimental techniques -Clamped circular plateunder a central load -Analytical solution,Fringecontours from various experimental techniques

UNIT II HologramInterferometry, SpeckleMethods **9**

Hologram interferometry -Steps in a double exposurehologram interferometry -Speckle methods Objectivespeckles, Subjective speckles

UNIT III Introduction toPhotoelastic Coatings **9**

Photoelastic coatings -Historical development, -Optical arrangements,-Photoelasticstrain gauges, Strainoptic relation for coating, -Evaluation of coating andspecimen stresses

UNIT IV Strain Sensitivity of aStrain Gauge, BridgeSensitivity, Rosettes **9**

Strain sensitivity of a strain gauge, -Transversesensitivity factor, -Gauge factor,-Experimentaldetermination of gauge factor, -Wheatstone bridge,-Strain measurement options,-Bridge sensitivity,-Bridgefactor, Accuracy achievable in Foil strain gauges, Linearity, -Hysteresis and Zero shift, -Determination ofstrain at a point, -Three element rectangular rosette

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UNIT V .Soldering, Accounting forTransverse SensitivityEffect **9**

Masking, Tinning,Soldering,Application of protective coating, Testing the installation, Transverse sensitivity, Actual and apparent strains, Corrections fortransverse strain effects for the case of known ratio ofthe transverse strain to the axial strain.

Total 45 Periods

Text books

1. K. Ramesh, e-Book on Experimental Stress Analysis, IIT Madras, 2009
2. J.W. Dally and W.F. Riley,Experimental Stress Analysis, McGraw-Hill, 1991.

.

References

1. L.S.Srinath, M.R. Raghavan,K. Lingaiah, G. Gargesa,B.Pant, and K.Ramachandra,Experimental Stress Analysis, Tata McGraw Hill, 1984..
2. K. Ramesh, Digital Photoelasticity – Advanced Techniques and Applications,Springer, 2000.

Web References

1.http://apm.iitm.ac.in/smlab/kramesh/book_5.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**	**3**
CO1	3	3	3	-	-	-	-	-	2	-	-	-	2	-	-
CO2	3	3	3	-	-	-	-	-	2	-	-	-	2	-	-
CO3	3	3	3	-	-	-	-	-	2	-	-	-	2	-	-
CO4	3	3	3	-	-	-	-	-	2	-	-	-	2	-	-
CO5	3	3	3	-	-	-	-	-	2	-	-	-	2	-	-
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom'sLevel	**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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

CHAIRMAN - BOARD OF STUDIES

20AEE48	Aircraft Structural health Monitoring Systems	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. StudyThe new type of smart sensor for health monitoring system.
2. Learn the damage detection using different technique
3. Introduce the development of sensor using smart materials for aerospace application
4. Provide knowledge on Analysis, assessment of manufactured sensor
5. Provide Knowledge ondifference between theoretical developments and engineering applications.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Develop the new type of smart sensor for health monitoring system.	Apply
CO2	Design the damage detection using different technique.	Apply
CO3	Understand the development of sensor using smart materials for aerospace application.	Understand
CO4	Analysis, assessment of manufactured sensor	Apply
CO5	Understand the difference between theoretical developments and engineering applications.	Understand

Course contents:

UNIT I Aircraft Structural Health and Usage Monitoring **9**

Introduction - aircraft structural damage - ageing aircraft problem - lifecycle cost of aerospace structures - aircraft structural design - damage monitoring systems in aircraft - non-destructive testing - structural health monitoring - emerging monitoring techniques and sensor technologies

UNIT II Operational Load Monitoring Using Optical Fibre Sensors **9**

Introduction - Fibre Optics - Sensor Target Specifications - Reliability of Fibre Bragg Grating Sensors - Fibre Coating Technology - Example of Surface Mounted Operational Load Monitoring Sensor System - Optical Fibre Strain Rosette - Example of Embedded Optical Impact Detection System

UNIT III Damage Detection Using Stress And Ultrasonic Waves **9**

Acoustic Emission – Ultrasonics - Acousto-ultrasonics - Guided Wave Ultrasonics - Piezoelectric Transducers - Passive Damage Detection Examples - Active Damage Detection Examples

UNIT IV Signal Processing For Damage Detection **9**

Introduction - Data Pre-processing - Signal Features for Damage Identification - Time–Domain Analysis - Spectral Analysis - Instantaneous Phase and Frequency - Time–Frequency Analysis - Wavelet Analysis - Dimensionality Reduction Using Linear and Nonlinear Transformation - Data Compression Using Wavelets Wavelet-based Denoising - Pattern Recognition for Damage Identification - Artificial Neural Networks.

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UNIT V Structural Health Monitoring Evaluation Tests **9**

Introduction - Large-scale Metallic Evaluator - Large-scale Composite Evaluator- Flight Tests - Summary

Total: 45 Periods

Text books:

1. Staszewski, W., Boller, C., & Tomlinson, G. R. (Eds.). (2004). Health monitoring of aerospace structures: smart sensor technologies and signal processing. John Wiley & Sons.

References:

1. Structural Health Monitoring for Space Systems (Aerospace Series) byAndreiZagrai (Editor), Brandon Arritt (Editor), Derek Doyle (Editor) Wiley-Blackwell ISBN-10: 1118729641

Additional references:

1. https://play.google.com/store/books/details?id=nzSPVBZ_Yg0C&rdid=book-zSPVBZ_Yg0C&rdot=1&source=gbs_vpt_read&pcampaignid=books_booksearch_viewport
2. https://onlinecourses.nptel.ac.in/noc18_oe05/preview
3. http://www.cism.it/courses/A1102/ 3.
4. http://courses.ce.metu.edu.tr/ce5802/2015/02/11/hello-world/

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	-	-	2	-	-	-	-	-	-	2	-	-
CO4	-	3	3	-	-	2	-	-	-	-	-	-	2	-	-
CO5	3	-	-	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 (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20AEE49	Nano Composite Materials	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Composite Materials and Structures				

Course Objectives

The course is intended to

1. Familiarize about the various types of nanomaterials and its dispersibility
2. Acquire the knowledge about the synthesis methods for the manufacturing of nanocomposite.
3. Acquaint with the various characterizing techniques
4. Learn the theory and modeling of nanocomposite materials..
5. Introduce the application of nanocomposite materials in different fields.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	know about the various types of nanomaterials and its dispersibility	Understand
CO2	Have the knowledge about the synthesis methods for the manufacturing of nanocomposite.	Apply
CO3	understand the various characterizing techniques.	Understand
CO4	know about the theory and modeling of nanocomposite materials.	Apply
CO5	know about the application of nanocomposite materials in different fields.	Understand

Course Contents:

Unit I Introduction to Nano Composite Materials **9**

Nanomaterials –classification of Nanomaterials,carbon and – non carbon based nanomaterialsproperties of materials, different polymers such as thermoplastic, thermoset and elastomer - characterization of nanocomposite materials and their dispersibility.

Unit II Synthesis of Nanocomposites **9**

Top Down Approach Grinding, Planetary milling and Comparison of particles, Bottom Up Approach, Wet Chemical Synthesis Methods, Preparation technologies - mechanical alloying, Colloidal Nanoparticles production, Sol Gel Methods, Gas phase Production Methods: physical/Chemical Vapour Depositions

Unit III Characterization of Nanocomposites **9**

Morphological Studies – Scanning Electron Microscopy (SEM) / Transmission Electron Microscopy (TEM) / Atomic Force Microscopy (AFM) — Structural and Thermal studies – Melt Flow Index (MFI) – Fourier transform Infra-red (FTIR) – X Ray Diffraction (XRD).

Unit IV Multi Scale Modeling In Nanocomposites **9**

Nanocomposite materials modeling: current issues. Multiscalemodeling. Multi-physics modeling, Basics of MD simulations, modeling of nanocomposites and its constituents.

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Unit V Applications to Nanocomposites **9**

Nanocomposites for fiber reinforced polymer matrix composites, Thermoplastic elastomer nanocomposites for propulsion systems, Thermoset nanocomposites for rocket ablative materials, nano modified carbon-carbon composites, Sensors for aerospace and defense applications

Total: 45 Periods

Text Books:

1. Ajayan P.M., Schadler L.S., Braun P.V. "Nanocomposites Science and Technology", Wiley-VCH, 2003.
2. Joseph H. Koo, “Polymer Nanocomposites”: Processing, Characterization and applications, McGraw-Hill Nanoscience and Technology series(McGraw-Hill professional, 2006..

Reference Books:

1. Riichiro Saito, Gene Dresslhaus, and Dresselhaus M.S., "Physical Properties of Carbon Nanotubes", Imperial College Press, 1999
2. K KChattopadhyayAnd A N Banerjee, Introduction To Nanoscience And Nanotechnology, PHI Learning, ISBN-978-81-203-3608-7, 2009.
3. Shaker A. Meguid, Advances in Nanocomposites: Modeling, Characterization and Applications, Springer International Publishing, ISBN:978-3-319-31660-4, 2016.

Additional References:

1. https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php
2. https://nptel.ac.in/courses/118102003/27

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	-	3	1	-	-	-	-	-	-	3	-	-
CO3	-	3	3	-	-	2	-	-	-	-	-	-	3	-	-
CO4	-	3	3	-	-	3	-	-	-	-	-	-	2	-	-
CO5	3	-	-	3	3	3	-	-	-	-	-	-	2	-	-
	3	High				2	Medium					1	Low		

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

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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

20AEE50	Hyper Mesh	L	T	P	C
		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Finite Element Analysis				

Course Objectives

The course is intended to

1. Impart knowledge on the application of software in solving aerospace problems.
2. Provide knowledge on mesh type for solving the problem.
3. Impart knowledge on solving the FEA problem.
4. Provide knowledge on capturing the results and saving the file in required formats.
5. Provide knowledge on the meshing techniques in commercial software.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Understand the application of software in solving aerospace problems	Understand
CO 2	Identify the appropriate mesh type for solving the problem	Understand
CO 3	Create a collector to solve the FEA problem	Apply
CO 4	Capture the results and save the file in required formats	Apply
CO 5	Apply the meshing techniques in commercial software	Apply

Course Contents:

UNIT I Introduction to Hyper Mesh **9**

Introduction to CAD & CAE, Application of CAE Software, Advantages and Introduction to geometry tools and creation of surface.

UNITII Meshing **9**

Introduction to Meshing, structured and unstructured mesh, 1D, 2D and 3D, Mesh quality and quality index, 1D and 2D size optimization.

UNIT III Creating an FEA Model **9**

Deck preparation, Model Organization: Collectors, Material and properties assignment, Assign of loads and constraints, setup solver.

UNIT IV Solving and Exporting **9**

Post-processing: Viewing a Deformed Shape, Viewing a Contour Plot Exporting FE data to various Solvers like ANSYS, LS Dyna and Radioss.

UNIT V Meshing In Commercial Software **9**

Grid Generation in commercial software, Hyper mesh, GAMBIT, ANSYS Mesh, ICEM CFD, Turbo Grid.

Total: 45 Periods

Text Book:

1. Hyper Mesh Basic Training, Volume 1, 2003 Altair Engineering, Inc.

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Reference Books:

1. Grid Generation Methods by Vladimir. D. Liseikin, 2009, Google Books
2. Numerical Grid Generation by Dr. Joe. F. Thompson, 2009, Thomas & Reuters
3. Handbook of Grid Generation by Nigel P. Weatherill, N. P. Weatherill, Joe F. Thompson, 1998

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				

CHAIRMAN - BOARD OF STUDIES

20AEE51	Helicopter Theory and Maintenance	L	T	P	C
		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Fundamentals Of Aeronautics				

Course Objectives

The course is intended to

1. Introduce fundamental aspects on helicopter rotor aerodynamics, generation of lift and rotor control & efficiency to students
2. Make students familiarize with the concepts like hovering and vortex ring state and calculation of induced power
3. Make students knowledgeable on helicopter flight performance calculations and on criteria for selection of power plants
4. Acquaint students with lateral and longitudinal stability characteristics of helicopter and the differences between stability and control
5. Elucidate students on the structural problems peculiar to helicopter rotor like rotor vibration

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Perform the Aerodynamics calculation of Rotor blade	Understand
CO 2	Perform stability and control characteristics of Helicopter.	Understand
CO 3	Perform and control Rotor vibration.	Understand
CO 4	Explain the stability characteristics of a helicopter.	Understand
CO 5	Demonstrates the role of rotor vibrations in helicopter design.	Understand

Course Contents

Unit I Introduction **9**

Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, considerations on blade, flapping and feathering, Rotor controls and various types of rotor, Blade loading, Effect of solidity, profile drag, compressibility etc., Blade area required, number of Blades, Blade form, Power losses, Rotor efficiency.

Unit II Aerodynamics Of Rotor Blade **9**

Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect.

Unit III Power Plants And Flight Performance **9**

Piston engines, Gas turbines, Ramjet principle, Comparative performance, Horsepower required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.

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Unit IV Stability and Control **9**

Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter.

Unit V Rotor Vibrations **9**

Dynamic model of the rotor, Motion of the rigid blades, flapping motion, lagging motion, feathering motion, Properties of vibrating system, phenomenon of vibration, fuselage response, vibration absorbers, Measurement of vibration in flight. Rotor Blade Design: General considerations, Airfoil selection, Blade construction, Materials, Factors affecting weight and cost, Design conditions, Stress analysis.

Total: 45 Periods

Text Book

1. John Fay, Helicopter: history, piloting and How It Flies, Himalayan Books 1995.
2. Lalit Gupta, Helicopter Engineering; Himalayan Books New Delhi 1996.
3. Rathakrishnan E,Helicopter Aerodynamics,PHI Learning Pvt Ltd,NewDelhi,2019

References

1. Joseph Schafer, Basic Helicopter Maintenance (Aviation Technician Training CourseJS312642), Jeppesen 1980.
2. Prouty R W, Helicopter Aerodynamics, Phillips Pub Co, 1993.

Additional references:

1. https://nptel.ac.in/courses/101/104/101104017/
2. https://www.digimat.in/nptel/courses/video/101104071/L01.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**
CO 1	3	3	2		2	2			2		2	2	2		
CO 2	3	2	2		2	2			2		2	2	2		
CO 3	3	3	2	1	2	2	1		2		2		2		
CO 4	3	2	2	1	2	2	1		2		2		2		
CO 5	3	3	2	1	2	2	1		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	

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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				

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20AEE52	Airframe Maintenance and Repair	L	T	P	C
		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Fundamentals Of Aeronautics, Aircraft Structures				

Course Objectives:

The course is intended to

1. Familiarize with various types of airframe repairs and inspection procedures.
2. Impart knowledge on the materials used for airframe components.
3. Impart knowledge Assembly and disassembling of airframe components.
4. Familiarize with the hydraulic and pneumatic components of airplanes.
5. Make the students understand safety procedure followed for repairing of airplanes.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Identify and apply the principles of function and safe operation to aircraft as per FAA	Understand
CO2	Demonstrate the general airframe structural repairs, the structural repair manual and structural control programme.	Understand
CO3	Perform airframe structural component inspection, corrosion repair and non-destructive inspection.	Understand
CO4	Do aircraft component disassembly, reassembly and troubleshooting.	Understand
CO5	Acquire knowledge on aircraft adhesives, sealants, bonding techniques, repair procedures and the types and detection of defects in aircraft composite materials, Identify, install, inspect, fabricate and repair aircraft sheet metal and synthetic, material structures.	Understand

Course Contents:

Unit I Maintenance of Aircraft Structural Components **9**

Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser welding. Sheet metal repair and maintenance: Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Peening - Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Testing. Riveted repair design - Damage investigation - Reverse engineering.

Unit II Plastics and Composites In Aircraft **9**

Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks and holes - various repairs schemes - Scopes. Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test - Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Vacuum-bag process. Special precautions – Autoclaves

Unit III Aircraft Jacking, Assembly and Rigging **9**

Airplane jacking and weighing and C.G. Location. Balancing of control surfaces - Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

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Unit IV Review of Hydraulic and Pneumatic System **10**

Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Rain removal system - Position and warning system - Auxiliary Power Units (APUs).

Unit V Safety Practices **8**

Hazardous materials storage and handling, Aircraft furnishing practices - Equipments. Trouble shooting. Theory and practices.

Total: 45 Periods

Text books:

1. Hajra Choudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2018.
2. NagendraParashar B.S. and Mittal R.K., “Elements of Manufacturing Processes”, Prentice- Hall of India Private Limited, 2011.

References:

1. Serope Kalpajian, Steven R.Schmid, “Manufacturing Processes for Engineering Materials”, Fourth Edition, Pearson Education, Inc. 2018.
2. “H.M.T. Production Technology - Handbook”, Tata McGraw-Hill, 2017.
3. Adithan. M and Gupta. A.B., “Manufacturing Technology”, New Age, 2012.
4. Jain. R.K. and S.C. Gupta, “Production Technology”, Khanna Publishers. 19th Edition.2012
5. Roy. A. Linberg, “Process and Materials of Manufacture”, PHI, 2011.

Additional references:

1. https://nptel.ac.in/courses/101/104/101104071/

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	-	2	2	2	2	2	1	1	-	-	2	-	-
CO2	3	2	-	2	1	2	2	1	1	1	-	-	2	-	-
CO3		2	-	2	2	2	2	1	1	1	-	-	2	-	-
CO4	3	2	-	2	2	2	2	1	2	1	-	-	2	-	-
CO5	3	2	-	2	1	2	3	1	1	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	

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20AEE53	Aero Engine Maintenance and Repair	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Aerospace Propulsion				

Course Objectives

The course is intended to

1. To understand the basic concepts of the maintenance and repair of both piston and jet aero engines and the procedures followed for an overhaul of aero engines
2. To acquire the knowledge of the inspection and overhaul of both piston and jet engines

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the working principle of the piston engine and its components	Understand
CO2	Carry out the troubleshooting procedures for engine components	Understand
CO3	Analysis of symptom failure in, different engine system.	Apply
CO4	Outline the maintenance procedure for jet engines	Understand
CO5	Understand the troubleshooting procedures for aerospace engine components	Understand

Course Contents:

Unit I Piston Engines **9**

Carburation and Fuel injection systems - Ignition system components - spark plug detail – Engine operating conditions at various altitudes - Induction, Exhaust, and cooling system - Inspection and maintenance -troubleshooting - engine components - Daily and routine checks – Compression testing of cylinders - Special inspection schedules - Checks and inspection procedures

Unit II Jet Engines **9**

Bearings and seals - Inlets - compressors- turbines-exhaust section - Details of control, starting around running and operating procedures - Inspection and Maintenance- permissible limits of damage and repair criteria - internal inspection - compressor washing- field balancing of compressor fans- Component & Systems maintenance procedures - instruments for online maintenance - Foreign Object Damage(FOD) - Blade damage

Unit III Propellers **9**

Propeller theory - operation, construction assembly and installation - Pitch change mechanism- Propeller axially system- Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions - Damage and repair criteria.

Unit IV Testing and Inspection **9**

Symptoms of failure - Fault diagnostics - Rectification during testing equipments for overhaul: Tools and types of equipment - requirements for overhauling - Tools for inspection - Tools for safety and for visual inspection - Equipment for replacement of parts and their repair. Engine testing and procedures and schedule preparation - Online maintenance.

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Unit V Overhauling **9**

Engine Overhaul - Overhaul procedures - Cleaning of components - Repairs schedules for overhaul - Balancing of Gas turbine components. Trouble Shooting: Procedures for trouble shooting - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.

Total: 45 Periods

Text Books:

1. Thomas Wild, "Aircraft Power plants", 9th edition TATA McGraw Hill,New Delhi, 2018.
2. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engine, 2nd Edition, 2017.

Reference Books:

1. Dale Crane,"Aviation Maintenance Technician - Powerplants", 2nd Edition,Aviation Supplies &
2. Academics, Incorporated, 2011.
3. United Technologies Pratt and Whitney, "The Aircraft Gas turbine engine and its Operation",The
4. English Store, New Delhi, 2005.
5. "Federal Aviation Administration , Aviation Maintenance Technician Handbook-Powerplant",Volumes 1 and 2, Newcastle, WA: Aviation Supplies & Academics, 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**	**3**
CO1	3	3	2	2	2	-	-	-	-	-	1	2	3	2	3
CO2	2	3	2	2	2	-	-	-	-	-	1	2	3	2	3
CO3	3	3	2	2	2	-	-	-	-	-	1	2	2	2	3
CO4	2	2	2	2	2	-	-	-	-	-	-	2	2	2	3
CO5	3	2	3	2	2	-	-	-	-	-	1	2	2	2	3
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom'sLevel	**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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20AEE54	Theory of Elasticity	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Strength of materials				

Course Objectives

The course is intended to

1. Improve the ability to use the principles of theory of elasticity in engineering problems.
2. Analyze some real problem and to formulate the conditions of theory of elasticity application.
3. Familiarize with the stress function approach in solving linear elasticity problems.
4. Execute a reasonable choice of parameters of the model (geometry, material properties, and boundary conditions).
5. Provide the foundation for pursuing other solid mechanics courses such as theory of plates and shells, elastic stability, composite structures and fracture mechanics.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Have knowledge on the difference between Strength of Materials approach and Theory of Elasticity	Understand
CO2	Exhibit better understanding on the strain-displacement relation, stress-strain relations and stress ellipsoid	Apply
CO3	Demonstrate the knowledge on the classification of 2-D problems and the methods of solution.	Understand
CO4	Formulate of governing equations and solution for torsion of non-circular sections.	Apply
CO5	Solve the governing equation for plate bending.	Apply

Course Contents:

Unit I Basic Equations of Elasticity **9**

Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants

Unit II Plane Stress And Plane Strain Problems **9**

Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

Unit III Polar Coordinates **9**

Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs.

Unit IV Torsion **9**

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.

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Unit V Introduction to Theory of Plates and Shells **9**

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

Total: 45 Periods

Text books:

1. Ansel C Ugural and Saul K Fenster, "Advanced Strength and Applied Elasticity", 4th Edition, Prentice Hall, New Jersey, 2003.
2. Bhaskar, K., and Varadan, T. K., "Theory of Isotropic/Orthotropic Elasticity", CRC Press USA, 2009.
3. Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw – Hill Ltd., Tokyo, 1990.98

References:

1. Barber, J. R., "Elasticity", Kluwer Academic Publishers, 2004
2. Sokolnikoff, I. S., "Mathematical Theory of Elasticity", McGraw – Hill, New York, 1978.
3. Volterra & J.H. Caines, "Advanced Strength of Materials", Prentice Hall, New Jersey, 1991
4. Wang, C. T., "Applied Elasticity", McGraw – Hill Co., New York, 1993.

Additional References:

1. https://nptel.ac.in/courses/105/105/105105177/
2. https://nptel.ac.in/courses/101/104/101104005/

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	3	-	2	-	-	-	-	1	2	-	-
CO2	3	2	2	2	2	-	2	-	-	-	-	1	2	-	-
CO3	3	3	2	2	3	-	2	-	-	-	-	1	2	-	-
CO4	3	3	2	2	2	-	2	-	-	-	-	1	2	-	-
CO5	3	2	2	2	2	-	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	

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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				

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20AEE55	Advanced Manufacturing Process	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Manufacturing Process				

Course Objectives

The course is intended to

1. The objective of this course is to teach the lean tools to attain optimum level in quality.
2. Students will get knowledge on how to meet the needs of customers while maintaining high standards of quality and controlling the overall costs involved in the production of a particularproduct.
3. Aims to develop the students to conserve energy and natural resources, and to ensure thatthey have minimal impact on the environment and society.
4. To introduce students the basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques
5. To give students an introduction to an advanced information process techniques.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technologies	Understand
CO2	Apply the concepts of JIT, Lean Manufacturing, and Agile Manufacturing methodologies	Remember
CO3	Assess the product life cycle, impact on environment and development of green manufacturing processes.	Remember
CO4	Implement variety of Additive Manufacturing (AM) technologies, their potential to support design and manufacturing	Remember
CO5	Apply artificial intelligence (AI) and data mining (DM) techniques to improve the efficiencyof manufacturing systems	Remember

Course Contents:

Unit I Lean Manufacturing **9**

Objectives of lean manufacturing-key principles and implications of lean manufacturing -traditional Vs lean manufacturing- flow-continuous improvement/Kaizen –worker involvement- 5S principles-elements of JIT - uniform production rate - Kanban system - Lean implementation, Reconciling lean with other systems - lean six sigma- lean and ERP - lean with ISO 9001:2000.

Unit II Agile Manufacturing **9**

The Agile Production Paradigm – Agile Manufacturing Vs Mass Manufacturing - Agile Practices - Agile practice for product development - Manufacturing agile practices - Implementing new technology - A checklist, technology applications that enhance agility - agile technology make or buy decisions. -

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Costing for Agile Manufacturing practices - Creating the learning factory: Imperative for success, factory becoming a learning factory, building a road map for becoming a learning factory

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Unit III Green Manufacturing **9**

Introduction to Green Manufacturing- impact of manufacturing in environmental ecology - green manufacturing strategies - Principles of green manufacturing and its efficiency – System model architecture and module- design and planning- control or tools for green manufacturing.(Qualitative Analysis, Consumption Analysis, Life Cycle Analysis, Efficiency, Sustainability tools). - Enabling techniques for assuring green manufacturing - Carbon footprint analysis and management of manufacturing processes

Unit IV Additive Manufacturing **9**

Overview- Additive Manufacturing Technology in product Development - CAD and Reverse Engineering - Data Processing for Additive Manufacturing Technology: CAD model preparation – Stereo lithography – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications - Powder Based Additive Manufacturing Systems - Selective Laser Sintering – Principles of SLS process - Process, advantages and applications.

Unit V Intelligent Manufacturing **9**

Goals of AI in manufacturing- Methods for production equipment selection and layout, Heuristic scheduling of multiple resources, Fuzzy multiple attribute decision making methods- Application of neural networks and fuzzy sets to machining and metal forming.

Total: 45 Periods

Text Books:

1. Badiru A.B., “Expert Systems Applications in Engineering and Manufacturing”, Prentice-Hall,New Jersey, 1st edition, 1992.
2. Kusiak, Andrew, “Intelligent Manufacturing Systems”, Prentice Hall, 1st edition, 1990.

Reference Books:

1. Black .J.T. and Kohser R.A, “DeGarmo’s Materials and Processes in Manufacturing”, Published by Wiley, 11th edition, 2011.
2. Chowdiah.M.P., “Agile Manufacturing”, IK International Publishing House Pvt Ltd,
3. Christian N. Madu, “Handbook of environmentally conscious manufacturing”, Springer US
4. Publishers, 1st edition, 2001.
5. John Schey, “Introduction to Manufacturing Processes”, Tata McGraw-Hill Education ,3rd edition,1999 .
6. Rao R. V, “Advanced Modeling and Optimization of Manufacturing Processes”, 2nd edition,2006.
7. Ronald G. Askin and Jeffrey B. Goldberg, “Design and Analysis of Lean Production Systems”,John Wiley and Sons, 2003.

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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	-	3	-	3	3	-	-	-	3	3	3	-
CO2	3	-	3	-	3	-	3	3	-	-	-	3	3	3	-
CO3	3	-	3	-	3	-	3	3	-	-	-	3	3	3	-
CO4	3	-	3	-	3	-	3	3	-	-	-	3	3	3	-
CO5	3	-	3	-	3	-	3	3	-	-	-	3	3	3	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom'sLevel	**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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

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20AEE56	DESIGN FOR MANUFACTURE AND ASSEMBLY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Manufacturing Engineering				

Course Objectives

The course is intended to

1. To understand the various components and functions of production and select the materials.
2. To know the recent trends in various machining, metal joining processes, metal casting and forging.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Outline the appropriate design for economical production and select the materials.	Understand
CO2	Select between various machining and metal joining processes.	Remember
CO3	Apply a systematic understanding of knowledge in the field of metal casting and forging.	Remember
CO4	Fabricate basic parts and assemblies using powered and non – powered machine shop equipment in conjunction with mechanical documentation.	Remember
CO5	Integrate the knowledge of compliance analysis and interference analysis for assembly and also use visco-elastic and creep in plastics.	Remember

Course Contents:

Unit I Metal Casting and Forging **9**

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.Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

Unit II Machining Process And Metal Joining **9**

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. 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 and Forging **9**

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.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 – liaison diagrams.

Total: 45 Periods

Text Books:

1. A K Chitale and R C Gupta, “Product Design and Manufacturing”, PHI, New Delhi, 2003.

Reference Books:

1. George E Deiter, “Engineering Design”, McGrawHill International, 2002.
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**	**3**
CO1	3	3	-	-	-	-	-	3	-	-	-	3	-	-	3
CO2	3	3	-	-	-	-	-	3	-	-	-	3	-	-	3
CO3	3	3	-	-	-	-	-	3	-	-	-	3	-	-	3
CO4	3	3	-	-	-	-	-	3	-	-	-	3	-	-	3
CO5	3	3	-	-	-	-	-	3	-	-	-	3	-	-	3
	3	High				2	Medium					1	Low		

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

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination**
	IAE- I	**IAE - II**	**IAE - III**	
	(7.5)	**(7.5)**	**(10)**	**(60)**
Remember	10	10	10	20
Understand	30	30	30	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

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20AEE57	Total Quality Management	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	NIL				

Course Objectives:

The course is intended to

1. This course deals with Quality concepts and TQM principles focusing on process quality to assure product quality to the customers.
2. It also deals with the Basic and modern Quality management tools including ISO standards.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Demonstrate the need, history and principles of Quality and TQM	Applying
CO2	Illustrate the principles and strategies of TQM	Applying
CO3	Make use of various tools and techniques of quality management	Applying
CO4	Apply various quality tools and techniques in both manufacturing and service industry	Applying
CO5	Explain the concepts of quality management system and ISO.	Applying

Course Contents:

Unit I Quality Concepts and Principles: 9

Quality Concepts and Principles: Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Basic concepts of Total Quality Management - Historical Review. Principles of TQM - Leadership –Concepts - Quality Council - Quality Statements - Strategic Planning - Deming Philosophy - Barriers to TQM Implementation.

Unit II Engineering Ethics 9

Total Quality Management-Principles and Strategies: Customer satisfaction –Customer Perception of Quality - Customer Complaints - Customer Retention - Employee Involvement –Motivation - Empowerment - Teams - Recognition and Reward - Performance Appraisal - Benefits. Continuous Process Improvement –Juran Trilogy - PDSA Cycle - 5S - Kaizen - Supplier Partnership –Partnering - sourcing - Supplier Selection - Supplier Rating - Relationship Development - Performance Measures

Unit III Control Charts for Process Control: 9

Control Charts for Process Control: The seven tools of quality - Statistical Fundamentals –Measures of central Tendency and Dispersion - Population and Sample - Normal Curve - Control Charts for variables and attributes - Process capability - Concept of six sigma.

Unit IV TQM-Modern Tools: 9

TQM-Modern Tools: The new seven tools of quality - Benchmarking-Need - Types and process; Quality Function Deployment-HOQ construction - case studies; Taguchi‟s Robust design-Quality loss function -

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DOE; Total Productive Maintenance-uptime enhancement; Failure Mode and Effect Analysis-Risk Priority Number - Process - case studies.

Unit V Quality Systems: **9**

Quality Systems: Need for ISO 9000 and Other Quality Systems - ISO 9000 : 2015 Quality System – Elements - Implementation of Quality System - Documentation - Quality Auditing - Introduction to TS 16949 - QS 9000 - ISO 14000 - ISO 18000 - ISO 20000 - ISO 22000. Process of implementing ISO - Barriers in TQM implementation.

Total: 45 Periods

Text books:

1. Dale H. Besterfield, "Total Quality Management", 3rd Edition, Pearson Education, New Delhi, 2011.

References:

1. Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill, New Delhi, 2008.
2. Feigenbaum A.V., "Total Quality Management", 4th Edition, Tata McGraw Hill , New Delhi, 2004
3. James R. Evans and William M. Lindsay, "The Management and Control of Quality",8th Edition, First Indian Edition, Cengage Learning, 2012.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
5. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.
6. ISO 9001-2015 standards

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	1				2	2	3	2	2	1	1		3	
CO2	1	1				3	2	3	3	3	1	1	2	3	
CO3	3	2	2	2	2	2		1	2	2	1	1	1	3	
CO4	2	2	2	2	2	2		1	2	2	1	1	2	3	
CO5						3	3	2	3	2	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	

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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				

CHAIRMAN - BOARD OF STUDIES

20AEE58	Production Planning and Control	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites					

Course Objectives

The course is intended to

1. To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
2. To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Identify the benefits of production planning and control	Understand
CO2	Do motion study, work measurement, time study and production study	Remember
CO3	Prepare production planning and control activities such as product planning and process planning	Remember
CO4	Prepare production scheduling and material requirement planning	Remember
CO5	Plan Manufacturing Requirement Planning (MRP II) and Enterprise Resource Planning (ERP).	Remember

Course Contents:

Unit I Introduction **9**

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration-Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

Unit II Work Study **9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

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Unit III Product Planning and Process Planning **9**

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Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

Unit IV Production Scheduling **9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

Unit V Inventory Control And Recent Trends In PPC **9**

Inventory control - Purpose of holding stock - Effect of demand on inventories - Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

Total: 45 Periods

Text Books:

1. James. B. Dilworth, ”Operations management – Design, Planning and Control for manufacturing and services” Mcgraw Hill International edition 1992.
2. Martand Telsang, “Industrial Engineering and Production Management”, First edition, S. Chand and Company, 2000.

Reference Books:

1. Chary. S.N., “Theory and Problems in Production & Operations Management”, Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, 8th Edition John Wiley and Sons, 2000.
3. Jain. K.C. & Aggarwal. L.N., “Production Planning Control and Industrial Management”, Khanna Publishers, 1990.
4. Kanishka Bedi, “Production and Operations management”, 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, “ Operations management – A value driven approach” Irwin Mcgraw hill.
6. Norman Gaither, G. Frazier, “Operations Management” 9th Edition, Thomson learning IE, 2007
7. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corpn.1984
8. Upendra Kachru, “ Production and Operations Management – Text and cases” 1st Edition, Excel books 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	-	-	-	3	-	-	3
CO2	3	-	-	-	-	-	-	2	-	-	-	3	-	-	3
CO3	3	-	-	-	-	-	-	2	-	-	-	3	-	-	3
CO4	3	-	-	-	-	-	-	2	-	-	-	3	-	-	3

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CO5	3	-	-	-	-	-	-	2	-	-	-	3	-	-	3
	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	50
Apply	10	10	10	30
Analyze				
Evaluate				
Create				

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20AEE59	Six Sigma & Lean Concepts	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	NIL				

Course Objectives:

The course is intended to

1. To gain insights about the importance of lean manufacturing and six sigma practices

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the six sigma methodologies.	Understand
CO2	Understand the implementation and challenges in six sigma	Understand
CO3	Understand the evaluation and continuous improvement methods	Understand
CO4	Understand the fundamentals of Lean and Six sigma	Understand
CO5	Understand the tools and techniques used in analysis	Understand

Course Contents:

Unit I Six Sigma Methodologies **9**

Design For Six Sigma (DFSS),Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder

Unit II Six Sigma Implementation and Challenges **9**

Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach –implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/internal metrics

Unit III Evaluation and Continuous Improvement Methods **9**

Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S

Unit IV Lean & Six Sigma Background and Fundamentals **9**

Historical Overview – Definition of quality – What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability

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– six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing – assessment questions

Unit V The Scope of Tools and Techniques **9**

Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

Total: 45 Periods

References:

1. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000
3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma:A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success,JohnWiley&Sons,2000
5. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 2003

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	1				2	2	3	2	2	1	1		3	
CO2	1	1				3	2	3	3	3	1	1	2	3	
CO3	3	2	2	2	2	2		1	2	2	1	1	1	3	
CO4	2	2	2	2	2	2		1	2	2	1	1	2	3	
CO5						3	3	2	3	2	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**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20

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Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20AEE60	**Nondestructive Testing**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of course	Professional Elective				
Pre requisites	Engineering Materials				

Course Objectives

The course is intended to

1. Impart knowledge on fundamental concepts of NDT.
2. Provide knowledge on different methods of NDE.
3. Impart knowledge on the concept of Thermography and Eddy current testing.
4. Provide knowledge on the concept of Ultrasonic Testing and Acoustic Emission.
5. Provide knowledge on the concept of Radiography.

Course Outcomes

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

CO. No.	**Course Outcome**	**Bloom's Level**
CO 1	Explain the fundamental concepts of NDT	Understand
CO 2	Discuss the different methods of NDE	Understand
CO 3	Explain the concept of Thermography and Eddy current testing	Understand
CO 4	Explain the concept of Ultrasonic Testing and Acoustic Emission	Understand
CO 5	Explain the concept of Radiography	Apply

Course Contents:

UNIT I Overview of NDT **9**

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT, Visual inspection – Unaided and aided.

UNITII Surface NDE Methods **9**

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III Thermography and Eddy Current Testing (ET) **9**

Thermography- Principles - Contact and non contact inspection methods - Advantages and limitation - Instrumentations and methods, applications - Eddy Current Testing - Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements- Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV Ultrasonic Testing (UT) and Acoustic Emission (AE) 9

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Acoustic Emission Technique –Principle, AE parameters, Applications.

UNIT V Radiography (RT) 9

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography.

Total: 45 Periods

Text Books:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2014.
2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010

Reference Books:

1. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005
2. ASM Metals Handbook,”Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
3. Charles, J. Hellier,“ Handbook of Nondestructive evaluation”, McGraw Hill, New York 2001.
4. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol.1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.

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

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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				

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OPEN ELECTIVE

20AE001	Drone Design anddevelopment	L	T	P	C
		3	0	0	3
Nature of Course	Open Elective				
Pre requisites	Fundaments of Aeronautics				

Course Objectives

The course is intended to

1. To know about the basic terminology and design stages of UAV and MAV.
2. To understand the aerodynamics, airframe configurations and structures.
3. To impart knowledge about the avionics system used in drones and MAV
4. To introduce the major application area of drones.
5. To expose the drone regulations and future challenges in mini-UAV.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Explain the basic terminologies to develop the UAV systems.	Understanding
CO2	Prepare preliminary design requirements for an unmanned aerial vehicle.	Analyze
CO3	Ability to identify different hardware for UAV	Understanding
CO4	Capability to identify the drone application areas.	Analyze
CO5	Design micro aerial vehicle systems for future challenges.	Understanding

Course contents:

Unit I Introduction **9**

History of UAV – Classifications – UAV System composition – UAS – Drones- Evolution of drones – Concepts of flight : aerodynamics – flight performance – stability andcontrol.

Unit II Unmanned Aerial System Components **9**

UAS - Platforms – Payload, installation and utilization - propulsion - on-board flight control - communications - Telemetry-tracking - launch / recovery systems - ground control stations – Trouble shooting.

Unit III Drone Anatomy andAssembly **9**

Multi rotor introduction - Drone Anatomy: Motor – Propeller - ESC – Flight controller – Transmitter–

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Receiver Sensors – Assembly – Autonomous system - Emergency identification and handling.

Unit IV Applications and Innovations of Drones **9**

Military – Civil : Health care – Public safety – Disaster Management - Wild life monitoring – Railways - Data collection – Environmental Science – Product delivery - Surveying – Traffic Management – Agriculture – Construction – Entertainment etc.

Unit V Operational Considerations and FutureScope **9**

DGCA regulations –CAR - NPNT – fly zones - Digital sky platform - Federal Aircraft Regulations - Future Prospects and Challenges- Case Studies – Mini and Micro UAVs

Total: 45 Periods

Text books:

1. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc, 1998.
2. Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.

References:

1. Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company,2001.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc,1998.
3. MirosawAdamski, "Power units and power supply systems in UAV", New Edition, Taylor and Francis Group publishers, 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**	**3**
CO1	3	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	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**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**(60)**

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Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20AE002	**Helicopter Technology**	**L**	**T**	**P**	**C**
		3	**2**	**0**	**4**
Nature of Course	Basic Sciences				
Pre requisites	Fundamental of Aeronautics				

Course Objectives

The course is intended to

1. To impart the knowledge of basic layout of helicopter.
2. To impart the knowledge of aerodynamics of helicopter.
3. To impart the knowledge to study the performance and stability aspects of Helicopter under different operating conditions.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	To perform the Aerodynamics calculation of Rotor blades	Understand
CO2	To perform stability and control characteristics of Helicopter	Apply
CO3	To perform and control Rotor vibration	Understand
CO4	Apply Momentum and simple blade element theories to helicopter's rotor blades.	Apply
CO5	Analyze the power requirements in forward flight and associated stability problems of helicopter.	Analyze

Course Contents:

Unit I Introduction **9**

Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, considerations on blade, flapping and feathering, Rotor controls and various types of rotor, Blade loading, Effect of solidity, profile drag, compressibility.

Unit II Aerodynamics of Rotor Blade **9**

Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect.

Unit III Power Plants and Flight Performance **9**

Piston engines, Gas turbines, Ramjet principle, Comparative performance, Horsepower required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.

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Unit IV Stability and Control **9**

Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter

Unit V Rotor Vibrations **9**

Dynamic model of the rotor, Motion of the rigid blades, flapping motion,feathering motion, Properties of vibrating system,vibration absorbers, Measurement of vibration in flight. Rotor Blade Design: General considerations, Airfoil selection, Blade construction, Materials.

Total: 45 Periods

Text Books:

1. John Fay, "The Helicopter and How It Flies", Himalayan Books 1995
2. Lalit Gupta, "Helicopter Engineering", Himalayan Books New Delhi 1996

Reference Books:

1. Joseph Schafer, "Basic Helicopter Maintenance", Jeppesen 1980
2. R W Prouty, Helicopter Aerodynamics, Phillips Pub Co, 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	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)**	

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Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20AEO03	**Air Traffic Control**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Open Elective				
Pre requisites	Aircraft Systems & Instruments				

Course Objectives

The course is intended to

1. Improve the basic concepts of air traffic control.
2. Analyze some real problem in air traffic systems
3. Familiarize flight information system.
4. Improve the basic knowledge in aerodrome data.
5. Provide the foundation of navigation and other data.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the basic concepts of air traffic control	Understand
CO2	Remember the air traffic system	Understand
CO3	Understand the flight information system	Understand
CO4	Remember the basic knowledge in aerodrome data	Understand
CO5	Remember the foundation of navigation and other data	Understand

Course contents:

Unit I Basic Concepts **9**

Objectives of air traffic control systems - Parts of ATC services – Scope and Provision of ATCs – VFR & IFR operations – Classification of ATS air spaces – Various kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.

Unit II Air Traffic Systems **9**

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Area control service, assignment of cruising levels - minimum flight altitude - ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance –ATC clearances – Flight plans – position report

Unit III Flight Information Systems **10**

Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and co ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

Unit IV Aerodrome Data **9**

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physicalCharacteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.

Unit V Navigation and Other Services **8**

Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights,general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.

Total: 45 Periods

Text Book

1. AIP (India) Vol. I & II, “The English Book Store”, 17-1, Connaught Place, New Delhi.

References

1. “Aircraft Manual (India) Volume I”, latest Edition – The English Book Store, 17-1, Connaught Place, New Delhi.
2. “PANS – RAC – ICAO DOC 4444”, Latest Edition, The English Book Store, 17-1, Connaught Place, New Delhi.

Additional references:

1. https://nptel.ac.in/courses/105/101/105101008/
2. https://nptel.ac.in/courses/101/108/101108047/

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	2	3	-	-	-	-	-	-	-	1	2	-	-
CO2	2	2	2	3	-	-	-	-	-	-	-	1	2	-	-
CO3	2	2	2	3		-	-	-	-	-	-	1	2	-	-
CO4	2	2	2	3	-	-	-	-	-	-	-	1	2	-	-
CO5	2	2	2	3	-	-	-	-	-	-	-	1	2	-	-

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	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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20AEO04	Automobile Aerodynamics	L	T	P	C
		3	0	0	3
Nature of Course	Open Elective				
Pre requisites	Aerodynamics –I, Fluid Mechanics				

Course objectives:

The course is intended to

1. At the end of the course, the students will be able to apply basic principles of aerodynamics for the design of vehicle body
2. To learn the basics of fluid mechanics on vehicle motion and expose to the optimization techniques followed in automotive industry in reducing aerodynamics drag, fuel consumption and improving vehicle stability

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO 1	Know the forces & moments influencing drag	Understand
CO 2	Solve simple numericals related to fuel economy & drag	Analyze
CO 3	Learn the techniques of optimization practiced in industry	Understand
CO 4	Learn the relation between drag, stability & fuel economy	Understand
CO 5	Expose to fundamentals of numerical & experimental testing	Apply

Course Contents

Unit I Introduction **9**

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

Unit II Aerodynamic Drag of Cars **9**

Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

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Unit III Shape Optimization of Cars **9**

Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners.

Unit IV Vehicle Handling **9**

The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles.

Unit V Wind Tunnels for Automotive Aerodynamics **9**

Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

Total: 45 Periods

Textbook:

1. Hucho.W.H. - “Aerodynamic of Road Vehicles” - Butterworths Co., Ltd., - 1997.
2. Joseph Katz,“Automotive Aerodynamics” Wiley – 2016

References:

1. Pope - “Wind Tunnel Testing “ - John Wiley & Sons - 2nd Edition, New York - 1974.
2. R.H.Barnard - “Road vehicle aerodynamic design, An Introduction” , Mechaero publications, Third edition-1996
3. Hucho .W.H. – “Aerodynamic of Road Vehicles – From Fluid Mechanics to Vehicle Engineering”Society of Automotive Engineers,U.S,Fourth edition,2013

Web references:

1. https://nptel.ac.in/courses/101/106/101106035/

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	-	-	1	-	2	-	-	-	-	-	2	2	1	-
CO2	3	-	-	1	1	2	-	-	-	-	-	2	2	1	-
CO3	3	-	-	1	1	2	-	-	-	-	-	2	2	1	-
CO4	3	-	-	1	1	2	-	-	-	-	-	1	2	1	-
CO5	3	-	-	1	1	2	-	-	-	-	-	1	1	1	-
	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

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20AEO05	Avionics	L	T	P	C
		3	0	0	3
Nature of Course	Open Electives				
Pre requisites	NA				

Course Objectives

The course is intended to

1. To know about the avionics need upon space and aircrafts
2. Able to learn Digital avionics architecture
3. To analyze the performance of various cockpit display technologies
4. Integrate avionics navigation systems
5. Ability to design and perform analysis on air system

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Learn about the need of avionics and its design	Understand
CO2	Possibility to learn about the architecture and microprocessor procedures	Understand
CO3	Gaining knowledge on display technologies	Understand
CO4	Learn about aircraft navigation systems and its functions	Understand
CO5	Creativity on finding the air data quantities and autopilot	Apply

Course contents:

Unit I Introduction to Avionics **9**

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems – design and technologies –memories

Unit II Digital Avionics Architecture **9**

Avionics system architecture – Microprocessor 8085 – MIL-STD-1553B – ARINC – 429 – ARINC – 629

Unit III Flight Decks and Cockpits **9**

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS

Unit IV Introduction to Navigation Systems **9**

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Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

Unit V Air Data Systems and Auto Pilot **9**

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot

Total: 45 Periods

Text books

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
2. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.

References

1. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
2. Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
3. Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.
4. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000

Web References:

1. https://nptel.ac.in/courses/101/108/101108056/

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	3	3	2	2	-	1	2	1	-	2	2	3
CO2	3	2	2	3	3	2	2	-	1	2	1	-	2	2	3
CO3	3	2	2	3	3	2	2	-	1	2	1	-	2	2	3
CO4	3	2	2	3	3	2	2	-	1	2	1	-	2	2	3
CO5	3	2	2	3	3	2	2	-	1	2	1	-	2	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**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	**(60)**

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Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20AEO06	**Aircraft Power Plant**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective				
Pre requisites	Aero Engineering Thermodynamics				

Course Objectives

The course is intended to

1. Familiarize about reciprocating engine construction
2. Acquire the knowledge about IC engines
3. Learn about the principles of lubricating systems
4. To understand about superchargers and turbochargers
5. To learn about the fuel systems and carburetors

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understanding about the reciprocating engine construction	Understand
CO2	Gaining Knowledge about the IC engines	Apply
CO3	Familiarizing on Lubricating systems	Apply
CO4	Interpreting the applications of superchargers and turbochargers	Apply
CO5	Gaining knowledge about fuel systems and carburetors	Understand

Course contents:

Unit I Reciprocating engine construction

Crankcase – bearings- crankshaft – connecting rod assemblies – pistons – cylinders-valves and associated parts – accessory section – propeller reduction gears

Unit II IC Engines

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Fundamentals – valve timing - two stroke engine – rotary engine – diesel engine – power calculations – engine efficiency – factors affecting performance

Unit III Lubricating system

Classification of lubricants – properties – need – functions – characteristics and components – engine design features related to lubrication

Unit IV Superchargers and turbochargers

Basic induction system – principle of superchargers and turbochargers – internal single speed supercharger –reciprocating engine cooling systems – reciprocating engine exhaust systems

Unit V fuel systems and carburettors

Characteristics of gasoline – principle of fuel systems – float type carburettors - carburettor icing – inspection and overhaul – principle of pressure ignition – pressure carburettors for small engines – pressure carburettors for large engines - water injection

Text books:

1. Thomas W. Wild and Michael J Kroes, “Aircraft powerplants” McGraw Hill , 8th edition, 2014.

References:

1. Charles E. Otis, Peter A Vosbury, “Aircraft Gas Turbine Powerplants Textbook and Workbook”, Aircraft Technical Book Co. 3rd 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	3	3	2	2	2	-	-	-	-	-	1	2	3	2	3
CO2	2	3	2	2	2	-	-	-	-	-	1	2	3	2	3
CO3	3	3	2	2	2	-	-	-	-	-	1	2	2	2	3
CO4	2	2	2	2	2	-	-	-	-	-	-	2	2	2	3
CO5	3	2	3	2	2	-	-	-	-	-	1	2	2	2	3
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’sLevel	**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**

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	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				

20AE007	**Basics of Aeronautical Science**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Core				
Pre requisites	Engineering physics				

Course Objectives:

The course is intended to

1. To introduce the basic concepts of aircrafts, rockets, satellites and their development.
2. To impart knowledge about the basic parts and their function and construction.
3. To know the basics of propulsion and application of rockets.

Course Outcomes

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

CO. No.	**Course Outcome**	**Bloom's Level**
CO1	Understand the evolution of aircrafts and flying vehicles.	Understand
CO2	Understand the parts and function of aircrafts.	Understand
CO3	Obtain knowledge on principles of flight.	Understand
CO4	Understand the fundamentals of structures and materials used.	Understand
CO5	Understand the principles of aircraft and rocket propulsion.	Understand

Course Contents:

Unit I history of Aerospace Engineering **9**

Historical evolution**;** Developments in aerodynamics, materials, structures and propulsion over the years.

Unit II Classification Aircraft **9**

Components of an airplane and their functions; Different types of flight vehicles, classifications; Basic instruments for flying.

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Unit III Principles of Flight **9**

Principles of flight**-** Evolution of lift, drag and moment; altitude and standard atmosphere – Airfoil and nomenclature – Basic aerodymanics.

Unit IV Aircraft Materials and Structures **9**

General types of Aircraft construction, Fuselage and Wing Structure; Aerospace materials, metallic and non-metallic materials.

Unit V Aircraft Propulsion **9**

Basic ideas about piston, turboprop and jet engines, Basic Propeller theory; Principles of operation of rocket, types of rockets and typical applications, Exploration into space.

Total: 45 Periods

Text books:

1. John D Anderson Jr, ”Introduction to Flight”,Tata McGraw Hill Education Private Limited, NewDelhi, 5th Edition, 2009.
2. A.C Kermode, “Flight without Formulae” , Pearson Education,5th Edition, 2008.

References:

1. Anderson. David, Wand Scott Eberhardt. “Understanding Flight”. 2nd ed. McGraw-Hill Professional, 2009.
2. Ashish Tewari, “Basic Flight Mechanics: A Simple Approach Without Equations”, Springer, 2016.
3. Lloyd Dingle, Mike Tooley, “Aircraft engineering principles“,Second Edition, ButterworthHeinemann, 2005.
4. Jim Winchester, “Concept Aircraft” Thunder Bay Press, 2005

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	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO5	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	

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20AEO08	**Airport Management**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of course	Open Elective				
Pre requisites	Principles of Management, Air Traffic Control and Planning				

Course Objectives

The course is intended to

1. Impart knowledge on the airport management.
2. Provide knowledge on Airport Authority.
3. Impart knowledge FAR.
4. Provide knowledge on Air traffic management.
5. Impart knowledge on Cargo and Business applications.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	Identify the concept of Airport Planning.	Understand
CO 2	Relate the airport authority	Understand
CO 3	Identify the Airport Rules and Regulations	Understand
CO 4	Identify the Air Traffic Control	Understand
CO 5	Identify the Industrial Management	Apply

Course Contents

Unit –I Airport Planning and Terminal Operations **9**

Airport Management – Airport Planning - Terminal Planning – Precautions – Terminal Designing – Terminal Operation.

Unit –II Airport Authorities and Functions **9**

Airport Operations – Airport Functions – Organization structure of Airline Sectors – Airport Authorities – Global Indian scenario of Airport management.

Unit –III Airport Regulations and Services **9**

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International trends in Airport transport services – Emerging Indian scenario – Private participation in International and Indian airports – environmental regulations – Regulatory issues – Airport fees, rates and charges.

Unit –IV Air Traffic Control and Processes **9**

Traffic Control – airspace - navigational aids – controlling process – coordination – responses to emergencies and airport security.

Unit –V Transportation of Business and Industrial Management **9**

Entrepreneurship in Transport industry – starting Travel agency / sub –agency – transport business – government support – allied businesses, sightseeing, Hotel booking, car rentals – Future opportunities in transport industry

Total : 45 Periods

Text Books

1. Principles of Airport Economics, PS Senguttavan, Excell Books
2. Airport systems : Planning, designing and management , Richard De Neufville, McGraw Hill 2007

Reference Books

1. Managing Airports : An international perspective, Graham .A, oxford 2001
2. The Airport Business Routledge, Doganis

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

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Understand	40	40	20	60
Apply			20	20
Analyze				
Evaluate				
Create				

20 AEO09	**Rocket and Space Science**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Open Elective				
Pre requisites	Aerodynamics, Propulsion				

Course Objectives

The course is intended to

1. To introduce concepts of system design used for space exploration.
2. Knowledge on mission design parameters from first principles of mechanics.
3. Understand the fundamentals of orbital mechanics.
4. Introduce sub-systems of a space vehicle.
5. To identify the communication systems for space vehicles

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Perform mission design calculations using specialized software.	Understand
CO2	Evaluate the orbits of space vehicles using classical methods.	Apply
CO3	Analyze dynamics of space vehicles.	Understand
CO4	Identify design requirements for different phases of a space exploration program.	Apply
CO5	Explain the variations of design concepts implemented in recent space missions	Understand

Course contents:

UNIT I Environment and Mission Design **9**

Earth environment, launch environment, atmosphere, space and upper atmosphere; earth-bound orbits, lunar and deep space missions, advanced missions, launch vehicle selection, launching and deployment Classification of missiles.

UNIT II Trajectory of a Rocket **10**

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Mass ratio and propellant mass fraction; equation of motion of an ideal rocket; motion of a rocket in a gravitational field; simplified vertical trajectory; burn-out velocity and burn-out height; step-rockets; ideal mission velocity and losses; effect of launch angle; factors causing dispersion of rockets in flight; dispersion of finned rockets; stability of flight.

UNIT III Astrodynamics **8**

Tactical Orbits and trajectories, Kepler's laws, orbital velocity and periods, eccentric elliptical orbits; effect of injection conditions, effect of earth's rotation, perturbation analysis; parking orbit, transfer trajectory, impulsive shot; rendezvous; recent interplanetary missions

UNIT IV Atmospheric Entry, Attitude Determination and Control **10**

Entry flight mechanics, entry heating, entry vehicle design, aero-assisted orbit transfer; concepts and terminology of attitude determination, rotational dynamics, rigid body dynamics, disturbance torques, passive attitude control, active control, attitude determination, system design considerations.

UNIT V Configuration, Structural Design, and Communications **8**

Design drivers and concepts, mass properties, structural loads; power sources, design drivers and practice, command subsystems, redundancy and autonomy, radio communications, tracking.

Total: 45 Periods

Text books:

3. M.D. Griffin and J.R. French, Space Vehicle Design. 2nd Edition, AIAA Education Series(2004).
4. J.W. Cornelisse, H.F.R. Schöyer, and K.F. Wakkar. Rocket Propulsion and SpacecraftDynamics. 1st Edition, Pitman (1979).

References:

3. E. Stuhlinger and G. Mesmer. Space Science and Engineering. 1st Edition, McGraw-Hill, New York (1965).
4. W.N. Hess. Space Science. 1st Edition, Blackie and Son (1965).

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	-	-	-	-	-	-	-	3	3	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	3	3	-	-
CO3	2	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	2	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	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	

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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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20AEO10	**Aircraft Maintenances**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Open Elective				
Pre requisites	Aircraft General Engineering and Maintenance Practices				

Course Objectives:

The course is intended to

1. Impart knowledge on aircraft maintenance operations.
2. Provide knowledge on Ground support equipment's.
3. Provide knowledge on aircraft engine inspection.
4. Impart knowledge on structural maintenance.
5. Impart knowledge on Aircraft Landing Gear maintenance.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the FAA airworthiness regulations and the checklist involved in each inspection of aircraft	Understand
CO2	Knowledge in various ground support system for aircraft operations.	Understand
CO3	Identify the engine components and faults	Understand
CO4	Identify the maintenance procedure to Aircraft Engines	Understand
CO5	Identify, install, inspect, fabricate and repair aircraft sheet metal and synthetic, material structures.	Understand

Course Contents

Unit –I Basic Concepts **7**

Maintenance concept, inspection periodicity for types of aircraft like Annual Inspection. 100 Hrs Inspection. Inspection schedule and operational life of components. Continuous air-worthiness maintenance Daily pre- flight and post flight inspection and maintenance of records.

Unit –II Grond Handling and Ground Support Equipments **8**

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Fire safety – classification of fire and extinguishing agents, Movement of Aircraft - Towing operation and precautions taxing and taxing signals. Aircraft tie down - Normal Tie down procedure, securing Light aircraft, Multi engine aircraft, Helicopters, Sea-planes and aircraft on skis Aircraft Tie down for storm condition - precautions against wind storm damage. Jacking aircraft & jacking precautions. Aircraft fueling operation and precautions. Description and Maintenance of ground support equipment's – Electrical power unit, Air start unit, Hydraulic power unit, Pre oiling equipment, Air conditioning and heating unit, Aircraft jacks, Tow Bars.

Unit –III Reciprocating Engine and Propeller Maintenance **10**

Concepts of maintenance and overhaul- general overhaul procedure- Inspection of engine parts- visual, magnetic, dimensional checks- things to be checked in a reciprocating engine common check on parts like cylinder head, cylinder barrel, piston, valves, crank case assembly and its system components. Importance of ground run, ignition system check, acceleration and deceleration checks and engine shut down and post stopping procedure. Inspection for propeller mounts, blade damages and oil leak. Variable pitch propeller only) Static and dynamic balancing of propellers- Purpose and procedure – Purpose and procedure for propeller track and run out checks. Permissible repairs on wooden propellers.

Unit –IV Gas Turbinate Engine Maintenance **10**

Division of engine cold section and hot section. Inspection of compressor section and blades, effects of foreign object damage, causes of blade damage, combustion section inspection and repairs inspection and repair of turbine, turbine blades and its replacement- inspection of exhaust section. Preparation of engine run up, initial warm up and full throttle checks, assessment of engine performance from various parameters viz, EPR, EGT, Fuel flow RPM etc.

Unit –V Aircraft Structural Repairs and Maintenance of Landing Gears **10**

Basic Principles of sheet metal repair, Maintaining the original strength and determination of rivet dia, and number of rivets for repair, Classification of sheet metal damage, special tools and devices for sheet metal, Metal working machines, Forming operations, Rivet layout, Riveting tools, Driving Rivets, Rivet failure, Removing Rivets, Specific Repair Types – Skin repair, Stringer repair, Bulkhead repairs, Longeron Repair, Spar repair, Rib and Web repair, Leading Edge and Trailing edge repair. Inspection and maintenance of landing gear - struts, wheel assembly, and brake system. Landing gear retraction test and its procedure. Special inspection after heavy handling, lightening strike and turbulent weather.

Total : 45 Periods

Text Books

1. Aircraft maintenance and repair – Kroes – Delp – 1993.
2. Airframe handbook – FAA –ACC 65 – 15A -1994
3. Power plant Hand book – FAA – AC 65 – 12A

Reference Books

1. Aircraft and power plants – Kroes and Wild – 1994
2. Airframe & Power plant mechanics – General Hand book AC 65-9A
3. Aircraft basic Science – Kroes&Rardon – 1993

Additional / Web References

1. https://nptel.ac.in/courses/101/104/101104071/
2. https://nptel.ac.in/courses/101/104/101104075/

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

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO5	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	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20AEA01	Wind Turbine Design and Testing	L	T	P	C
		1	0	0	1
Nature of Course	Employability Enhancement Courses				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Providing insight in wind turbine design and operation as well as of atmospheric flows
2. Learn the design and control principles of wind turbine.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Familiarity with principles of energy conversion	Understand
CO2	Understand the aerodynamically interaction between wind turbines and their surroundings	Understand
CO3	Understand wind and hydro energy resource assessment techniques	Understand
CO4	Develop experimental skills for energy related measurements and experiments	Understand
CO5	Understand the application of wind energy and wind energy conversion system.	Understand

Course contents:

Design of wind turbine

Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods

Reliability techniques for Wind Turbines

Introduction to reliability engineering, failure data analysis, failure distribution, Improvement in reliability, reliability testing, system reliability by Montecarlo simulation techniques tests and verification - Testing of wind turbine blades- Failure modes of wind turbine blades

TOTAL: 15 PERIODS

Textbooks

1. Wind Turbine Technology: Principles and Design, Muyiwa Adaramola · 2014
2. Wind Power Generation and Wind Turbine Design, Wei Tong
3. Wind Turbines: Fundamentals, Technologies, Application and Economics, Springer. Hau E. (2000).

References

1 . Wind Turbine Technology: Fundamental concepts of wind turbine technology Spera D.A. (ASME Press, NY, 1994)
2 . Wind Energy Systems – G.L. Johnson (Prentice Hall, 1985)
3. M. R. Patel, Wind and Solar Power Systems, CRC Press, 1999

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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	2	1											2		
CO2	2	1											2		
CO3	2	1											2		
CO4	2	1											2		
CO5	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 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
Analyze				
Evaluate				
Create				

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20AEA02	Real Time Industrial Applications in CFD	L	T	P	C
		1	0	0	1
Nature of Course	Employability Enhancement Courses				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Provide brief introduction of CFD along with Aerospace & chemical engineering application specifically, analysis of fluid mechanics and heat transfer related problems
2. Introduce some of the models required to compute turbulent and incompressible fluid flow problems

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Gain experience in the application of CFD analysis to real engineering designs	Understand
CO2	Build up skills in the actual implementation of CFD methods (e.g. boundary conditions, different numerical schemes etc.)	Understand
CO3	Understand the process of developing a geometrical model of the flow, applying appropriate boundary conditions, specifying solution parameters, and visualizing and analyzing the results.	Understand
CO4	Simulate simple CFD models and analyze its results	Analysis
CO5	Provide the student with a significant level of experience in the use of modern CFD software for the analysis of complex fluid-flow systems.	Understand

Course contents:

CFD Application in aerospace industry

Initial and boundary condition-External and Internal Aerodynamic Flow Modeling-Internal flows in Aerospace CFD- airflow around aircraft landing gear, Flow over CD nozzle

CFD Application in Food processing and other industries

Food industry modeling of high pressure food processing using CFD, CFD applications in membrane separations systems computation of airflow effects in microwave and combination heating.CFD applications in energy engineering research and simulation.

Total: 15 Periods

Textbooks

1. Computational Fluid Dynamics by Patrick J. Roache
2. Computational Fluid Dynamics in Food Processing, Da-Wen Sun

References

1. Cullity, B.D., “Elements of X-ray diffraction”, 3rd Edition, Addison-Wesley Company Inc., NewYork, 2000.

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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	2	1			3								2		
CO2	2	1			3								2		
CO3	2	1			3								2		
CO4	2	1			3								2		
CO5	2	1			3								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 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
Analyze				
Evaluate				
Create				

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20AEA03	Failure Analysis of Advanced Composites	L	T	P	C
		1	0	0	1
Nature of Course	Employability Enhancement Courses				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Illuminate the knowledge and analysis skills in applying basic laws in mechanics to the composite materials and its failure
2. Develop the student's skills in understanding the different damage mechanism

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	List the parameters that affects the property of a composite material	Understand
CO2	demonstrate recognition of failure mechanism and identify alternate materials and/or service conditions that prolong component life	Understand
CO3	Understand the deformation and failure mechanisms in a composite lamina and laminate	Understand
CO4	Analyze the effects of various load or displacement boundary conditions by applying laminate analysis to composite structures	Analysis
CO5	Predict the failure strength of a laminated composite plate	Understand

Course contents:

Intra and Inter-laminar damage mechanisms

Recapitulation of fracture mechanics, delamination, matrix cracking, fractographic observations, fiber compressive failure, fiber tensile failure, dynamic loading and impact damage, benchmark experiments to extract fracture parameters, laminate size effect on failure, effect of manufacturing induced defects on failure

Damage Detection

Variation of Welded Joints at Various Temperatures in Liquid-Phase-Pulse-Impact Diffusion Welding of Particle Reinforcement Aluminum Matrix Composites, defects, damage and role in the failure of composite materials

Implementation of composite damage models

Implementing damage models in commercial finite element programme via user defined material and user defined element packages, several aspects of damage modeling, and demonstrative 3D simulation of benchmark failure cases

Total: 15 Periods

Textbooks

1 . Failure analysis and fractography of polymer composites, mileS. Greenhalg, Woodhead publishing Ltd, 2017.
2. Failure analysis and prevention, Edited by AidyALi and Published by InTech Janeza Trdine 9, Croatia, 2016.
3. P.P. Camanho, S.R. Hallett, Numerical modeling of failure in advanced composite materials, Woodhead Publishing, 2015
4. Mechanics of composite materials by R. M. Jones, Taylor and Francis,2012

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References

1. Holm Altenbach, Tomasz Sadowski “Failure and damage analysis of Advanced materials” CISM, Udine 2015.
2. Advanced composite materials for automotive application, Structural Integrity and Crashworthiness by Ahmed Elmarakbi · 2013
3. Analysis and performances of Fiber composites by B. D. Agarwal, L. J. Broutman and K. Chandrasekhara, John Wiley & Sons, Inc,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		
CO2	3	1											2		
CO3	3	1			1								2		
CO4	3	2			1								2		
CO5	3	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 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
Analyze				
Evaluate				
Create				

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20AEA04	Technical Documentation For Aerospace Engineering Services	L	T	P	C
		1	0	0	1
Nature of Course	Employability Enhancement Courses				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Focuses on learning the Industry wide used Technical Writing and Illustration Standards and prepares you for Technical Publication domain
2. Learn about different tools and software used in aerospace documentation

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Explain the different standards used in aerospace technical publication	Understand
CO2	Prepare technical documentation for various aircraft parts	Understand
CO3	Understand schematic& wire diagram process.	Understand
CO4	Read different manuals available in aeronautical industry.	Understand
CO5	Use different tools and software used in technical publication	Understand

Course contents:

INTRODUCTION

Introduction to Tech Publication, Effective content creation, Tech Pub Standards-ATA 100,iSpec2200,ASD – STE100,Manual- Introduction to Aircraft and Engine manuals, aerospace standards, Aircraft Illustrated Parts Catalogue, Component Maintenance Manual ,Structural Repair Manual, Aircraft Schematic & Wiring Diagram Manual

Tools/Software Training

Software's-Arbor text Editor, Isodraw, Workflow of Technical Documentation-Tools and Technologies-Effect of Viscosity Ratio and Decay rate, Engineering Drawing Analysis, Technical Communication and Soft Skills

Total: 15 Periods

Textbooks

1. Technical Documentation and Process. Jerry C. Whitaker, Robert K. Mancini · 2018
2. Scientific and Technical Aerospace Reports Volume 29, Issue 22, 1991

References

1. Technical Documentation Overview, Hariom Baghel

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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	2									1	2		1		
CO2	2									1	2		1		
CO3	2									1	2		1		
CO4	2									1	2		1		
CO5	2				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 Class / Assignment	5	
	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	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

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20AEA05	Introduction to Aerospace Navigation	L	T	P	C
		1	0	0	1
Nature of Course	Employability Enhancement Courses				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Understand the concepts of navigation of aerospace vehicles
2. Impart ideas on aircraft and navigation instruments

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the concept of navigation, various navigation schemes and inertial sensors	Understand
CO2	Explain the different methods of inertial navigation and the sensors used in realizing practical inertial navigation systems	Understand
CO3	Exposure on various topics such as System Engineering, on-board software, safety of complex systems, FMS, ARINC 424 and Human interface and will be able to deploy these skills effectively in the solution of problems in avionics engineering	Understand
CO4	Exposure on various display systems, cockpit display, display architecture and graphics pertaining to aircraft display systems and will be able to deploy these skills effectively in the design and development of display systems for aircrafts.	Understand
CO5	Exposure on various Navigation systems such as Inertial Measurement systems, Radio Navigation Systems, Satellite Navigation – GPS	Understand

Course contents:

Satellite Navigation Systems

Navigation Problems Using Satellite Systems- Satellite Navigation Systems (GNSS) - GNSS Observables- Sources of Error- GNSS Receivers- Aerospace Applications

Inertial Navigation Systems

Reference Frames- Navigation Mechanization- INS Initialization- INS Error Characterization

Navigational Displays &on board software

Introduction to Modern Aerospace Navigational Displays- A Global Positioning System Receiver and Map Display - Automatic Dependent Surveillance Broadcast (ADSB) System Displays- Collision Avoidance and Ground Warning Displays. JAR 25-1309 regulations, DO-178 standards System aspects and software levels. Software development requirements, verification requirements, software configuration management requirements, software quality assurance requirements according to levels- case study

Total: 15 Periods

Textbooks

1. Aerospace Navigation Systems, Alexander V. Nebylov, Joseph Watson, 2016
2. M. Kayton and W. Fried: Avionics Navigation System, Wiley Interscience, 1997

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References

1. Nagaraja.M.S, Elements of electronic navigation, Tata McGraw Hill, 2015.
2 . P.T. Kabamba and A.R. Girard, Fundamentals of Aerospace Navigation and Guidance, Cambridge Aerospace Series, 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**	**3**
CO1	2				1								2		
CO2	2				1								2		
CO3	2				1								2		
CO4	2				1								2		
CO5	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 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
Analyze				
Evaluate				
Create				

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20AEA06	Disruptive Innovation Based Startup Activities	L	T	P	C
		1	0	0	1
Nature of Course	Employability Enhancement Courses				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. This course focuses on the pervasive need to leverage modern innovation and entrepreneurship in order to maintain competitiveness
2. Important aims of this course include learning how to recognize and selectively employ the diverse ways modern enterprises access innovative and entrepreneurial capabilities

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Comprehend the role of bounded rationality, framing, causation and effectuation inentrepreneurial decision making.	Understand
CO2	Demonstrate an ability to design a business model canvas.	Understand
CO3	Evaluate the various sources of raising finance for startup ventures.	Understand
CO4	Understand the fundamentals of developing and presenting business pitching topotential investors.	Understand
CO5	Role of institutions in promoting entrepreneurship.	Understand

Course contents:

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions-characteristics, traits and behavioral; entrepreneurial challenges.

Entrepreneurial Opportunities: Opportunities. Discovery / creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.

Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches**,** Effectuation and Causation.

Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of Organisation, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

Total: 15 Periods

Textbooks

1. Ries, Eric(2011), The lean Start-up: How constant innovation creates radically successful businesses, Penguin Books Limited.
2. Blank, Steve (2013), The Startup Owner's Manual: The Step by Step Guide for Building a Great Company, K&S Ranch.

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References

1. T. H. Byers, R. C. Dorf, A. Nelson, Technology Ventures: From Idea to Enterprise, McGraw Hill (2013)
2. Osterwalder, Alex and Pigneur, Yves (2010) Business Model Generation.
3. Kachru, Upendra, India Land of a Billion Entrepreneurs, Pearson
4. Bagchi, Subroto, (2012). MBA At 16: a Teenager's Guide to Business, Penguin Books
5. Bansal, Rashmi, Stay Hungry Stay Foolish, CIIE, IIM Ahmedabad
6. Bansal, Rashmi, (2013). Follow Every Rainbow, Westland.
7. Verstraete, T. and Laffitte, E.J. (2011). a Business Model of Entrepreneurship, Edward ,mElgar Publishing.
8. Johnson, Steven (2011). Where Good Ideas comes from, Penguin Books Limited.
9. Gabor, Michael E. (2013), Awakening the Entrepreneur Within, Primento.
10. Guillebeau, Chris (2012), The $100 startup: Fire your Boss, Do what you love andwork better to live more, Pan Macmillan
11. Kelley, Tom (2011), The ten faces of innovation, Currency Doubleday
12. Prasad, Rohit (2013), Start-up sutra: what the angels won't tell you about business and life, Hachette India.

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		
CO2	2				1								2		
CO3	2				1								2		
CO4	2				1								2		
CO5	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 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
Analyze				
Evaluate				
Create				

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