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

B.E. BIOMEDICAL ENGINEERING
REGULATION – 2023 V2
CHIOCE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULUM AND SYLLABI

I SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23MA102	Matrices and Calculus (Common to All Programmes)	BS	3	1	0	4	40	60	100
23LET07	Heritage of Tamils/தமிழர் மரபு	HSS	1	0	0	1	100	0	100
23BM101	Clinical biochemistry	PC	3	0	0	3	40	60	100
Theory with Practical Course(s)									
23ENE01	Communicative English	HSS	2	0	2	3	50	50	100
23CH101	Chemistry for Electrical Sciences (Common to BME, ECE &EEE)	BS	3	0	2	4	50	50	100
23CS12	Problem Solving using Python	ES	3	0	2	4	50	50	100
Practical Course									
23BM102	Clinical biochemistry Laboratory	PC	0	0	2	1	60	40	100
Mandatory Course									
23MC101	Induction Programme	MC	2 Weeks			0	100	-	100
TOTAL			**15**	**1**	**8**	**20**	**490**	**310**	**800**

II SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course (s)									
23MA202	Mathematical Foundations For Engineering (Common to All Programmes)	BS	3	1	0	4	40	60	100
23BM201	Medical Physics	PC	3	0	0	3	40	60	100
23BM202	Human Anatomy and Physiology	PC	3	0	0	3	40	60	100
23LET08	தமிழரும் தொழில்நுட்பமும் Tamils and Technology	HSS	1	0	0	1	100	0	100
Theory with Practical Course (s)									
23LEXXX	Language Electives – II	HSS	2	0	2	3	50	50	100
23PH201	Solid State Physics (Common to BME, ECE & EEE)	BS	3	0	2	4	50	50	100
23ME203	Engineering Graphics	ES	1	0	4	3	50	50	100
Practical Course									
23BM203	Human Physiology Laboratory	PC	0	0	2	1	60	40	100
Mandatory Course									
23MC202	Environmental Sciences	MC	2	0	0	0	100	-	100
Total			**18**	**1**	**10**	**22**	**530**	**370**	**900**

Language Electives – II

Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
23LEE02	Advanced Communicative English	HSS	2	0	2	3	50	50	100
23LEH03	Hindi	HSS	2	0	2	3	50	50	100
23LEF04	French	HSS	2	0	2	3	50	50	100
23LEG05	German	HSS	2	0	2	3	50	50	100
23LEJ06	Japanese	HSS	2	0	2	3	50	50	100

III SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23MA302	Probability And Statistics	BS	3	2	0	4	40	60	100
23BM301	Fundamentals of Bioinformatics	PC	3	0	0	3	40	60	100
23BM302	Electronic Device and Circuits	PC	3	0	0	3	40	60	100
23BM303	Signals and Systems for Bioengineers	PC	3	0	0	3	40	60	100
23UH001	Universal Human Values	HSS	3	0	0	3	40	60	100
Theory with Practical Course(s)									
23CS310	Object Oriented Programming And Data Structures	PC	3	0	2	4	50	50	100
Practical Course									
23BM305	Electronic Devices and Circuits Laboratory	PC	0	0	2	1	60	40	100
Mandatory Course									
23MC006	Soft Skills	MC	0	0	2	0	100	-	100
Total			**18**	**2**	**6**	**21**	**410**	**390**	**800**

IV SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23MA401	Numerical Methods	BS	3	2	0	4	40	60	100
23BM401	Digital Electronics and Integrated Circuits	PC	3	2	0	4	40	60	100
23BM402	Biosignal processing	PC	3	0	0	3	50	50	100
23BM403	Hospital Management	HSS	3	0	0	3	40	60	100
Theory with Practical Course(s)									
23BM404	Biosensors and Measurements	PC	2	0	2	3	50	50	100
23BM405	Pathology and Microbiology	PC	3	0	2	4	40	60	100
Practical Course									
23BM406	Biosignal processing Laboratory	PC	0	0	2	1	60	40	100
Mandatory Course									
23MC203	Interpersonal Skills	MC	0	0	2	0	100	-	100
23MC004	Constitution of India	MC	2	0	0	0	100	-	100
Total			**19**	**4**	**8**	**22**	**520**	**380**	**900**

V SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23BM501	Radiological Equipments	PC	3	2	0	4	40	60	100
23BM502	Biomedical Instrumentation	PC	3	0	0	3	40	60	100
23BM503	Biocontrol System	PC	3	2	0	4	40	60	100
23BMEXX	Professional Elective-I	PE	3	0	0	3	40	60	100
23YYOXX	Open Elective-I	OE	3	0	0	3	40	60	100
Theory with Practical Course(s)									
23BM504	Biomechanics and its practices	PC	3	0	2	4	50	50	100
Practical Course(s)									
23BM505	Biomedical Instrumentation Laboratory	PC	0	0	2	1	60	40	100
Mandatory Course									
23MC005	Yoga and Values for Holistic Development	MC	0	0	2	0	100	-	100
Total			**18**	**4**	**6**	**22**	**410**	**390**	**800**

VI SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23BM601	Regulatory Affairs and Medical Ethics	PC	3	0	0	3	40	60	100
23BM602	Biomaterials and Artificial Organs	PC	3	0	0	3	40	60	100
23BM603	Fundamentals of Healthcare Analytics	PC	3	0	0	3	40	60	100
23BMEXX	Professional Elective-II	PE	3	0	0	3	40	60	100
23YYOXX	Open Elective-II	OE	3	0	0	3	40	60	100
Theory with Practical Course									
20BM604	Diagnostic and Therapeutic Equipment	PC	3	0	2	4	40	60	100
Practical Course(s)									
23BM605	Design Thinking and Mini Project	EEC	0	0	4	2	40	60	100
23BM606	Internship	EEC	2 weeks			1	100	0	100
Total			**18**	**0**	**6**	**22**	**380**	**420**	**800**

VII SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Courses									
23BM701	Economics and Management for Bioengineers	HSS	3	0	0	3	40	60	100
23BM702	Medical Image Processing	PC	3	0	0	3	40	60	100
23BM703	Artificial Intelligence and Machine Learning for Healthcare	PC	3	0	0	3	40	60	100
23BMEXX	Professional Elective-III	PE	3	0	0	3	40	60	100
23BMEXX	Professional Elective-IV	PE	3	0	0	3	40	60	100
23YYOXX	Open Elective-III	OE	3	0	0	3	40	60	100
Practical Course(s)									
23BM704	Medical Image Processing Laboratory	PC	0	0	2	1	60	40	100
23BM705	Hospital Training	EEC	0	0	2	1	100	00	100
23BM706	Design Project	EEC	0	0	4	2	40	60	100
Total			**18**	**0**	**8**	**22**	**440**	**460**	**900**

VIII SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
23BMEXX	Professional Elective-V	PE	3	0	0	3	40	60	100
23BMEXX	Professional Elective-VI	PE	3	0	0	3	40	60	100
23BM801	Major Project	EEC	0	0	16	8	40	60	100
Total			**6**	**0**	**16**	**14**	**120**	**180**	**300**

PROFESSIONAL ELECTIVES (PE)									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
STREAM – 1 BIOMEDICAL SIGNAL AND IMAGE PROCESSING (BSIP)									
23BME01	Pysiological Signal Processing	PE	3	0	0	3	40	60	100
23BME02	Biometric Systems	PE	3	0	0	3	40	60	100
23BME03	Computer Vision and Pattern Recognition for Biological applications	PE	3	0	0	3	40	60	100
23BME04	Computational Medicine	PE	3	0	0	3	40	60	100
23BME05	Biostatistics	PE	3	0	0	3	40	60	100
23BME06	Quality Assurance & Medical Device Regulations	PE	3	0	0	3	40	60	100
23BME07	Medical Image Analysis	PE	3	0	0	3	40	60	100
23BME08	Brain Computer Interface and its Applications	PE	3	0	0	3	40	60	100
23BME09	Soft computing and applications	PE	3	0	0	3	40	60	100
23BME10	Deep Learning for Heathcare	PE	3	0	0	3	40	60	100
23BME11	Neuro-Science Engineering	PE	3	0	0	3	40	60	100
23BME12	Biomedical Data Science	PE	3	0	0	3	40	60	100
STREAM – 2 HEALTH CARE SYSTEMS (HCS)									
23BME21	Human Assist Devices	PE	3	0	0	3	40	60	100
23BME22	Robotics in Medicine	PE	3	0	0	3	40	60	100
23BME23	Medical Device Design and Prototyping	PE	3	0	0	3	40	60	100
23BME24	Tele Health Technology	PE	3	0	0	3	40	60	100
23BME25	Wearable Systems	PE	3	0	0	3	40	60	100
23BME26	Body Area Networks	PE	3	0	0	3	40	60	100
23BME27	Health Information Technology	PE	3	0	0	3	40	60	100
23BME28	Data communication and Networking	PE	3	0	0	3	40	60	100
23BME29	Internet of Things in Medicine	PE	3	0	0	3	40	60	100
23BME30	Medical Informatics	PE	3	0	0	3	40	60	100
23BME31	Genomics & Systems Biology	PE	3	0	0	3	40	60	100

23BME32	Computitional Biology	PE	3	0	0	3	40	60	100
STREAM – 3 BIOENGINEERING (BE)									
23BME41	Rehabilitation Engineering	PE	3	0	0	3	40	60	100
23BME42	Translational cell and Tissue Engineering	PE	3	0	0	3	40	60	100
23BME43	Molecular Biology	PE	3	0	0	3	40	60	100
23BME44	Biophotonics	PE	3	0	0	3	40	60	100
23BME45	Genetic Engineering	PE	3	0	0	3	40	60	100
23BME46	Nano Technology and Applications	PE	3	0	0	3	40	60	100
23BME47	Immuno Engneering	PE	3	0	0	3	40	60	100
23BME48	Bio MEMS and Micro fluids	PE	3	0	0	3	40	60	100
23BME49	Lab-on-Chip & Point-of-care Devices	PE	3	0	0	3	40	60	100
23BME50	Physiological Modelling	PE	3	0	0	3	40	60	100
23BME51	Medical Optics	PE	3	0	0	3	40	60	100

OPEN ELECTIVE COURSES (For Other Branches)									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
23BMO01	Principles of telemedicine	OE	3	0	0	3	40	60	100
23BMO02	Biosensor and wearable technology	OE	3	0	0	3	40	60	100
23BMO03	R-Program for Bioinformatics	OE	3	0	0	3	40	60	100
23BMO04	Introduction to Biomedical devices	OE	3	0	0	3	40	60	100
23BMO05	Medical nanotechnology	OE	3	0	0	3	40	60	100
23BMO06	Rehabilitation Engineering	OE	3	0	0	3	40	60	100
23BMO07	Medical electronics	OE	3	0	0	3	40	60	100
23BMO08	Biomedical instrumentation	OE	3	0	0	3	40	60	100
23BMO09	Hospital management	OE	3	0	0	3	40	60	100
23BMO10	Basics of Medical informatics	OE	3	0	0	3	40	60	100
23BMO11	Fundamentals of Biochemistry	OE	3	0	0	3	40	60	100
23BMO12	Basics of human anatomy and physiology	OE	3	0	0	3	40	60	100

ONE CREDIT COURSES									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
23BMA01	Scientific Computing for Biologists	EEC	1	0	0	1	100	0	100
23BMA02	Frontiers in Medical Informatics	EEC	1	0	0	1	100	0	100
23BMA03	Ultrasound Machine	EEC	1	0	0	1	100	0	100
23BMA04	IoT for Healthcare Applications	EEC	1	0	0	1	100	0	100
23BMA05	Ventilator with monitoring equipment	EEC	1	0	0	1	100	0	100
23BMA06	Human Computer Interaction	EEC	1	0	0	1	100	0	100
23BMA07	Digital manufacturing for Health Care	EEC	1	0	0	1	100	0	100

SUMMARY

S.No	Category	CREDITS PER SEMESTER									
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total Credits (AICTE)**	**Credits in %**
1	HSS	4	4	3	3			3		17 (10-14)	10.3%
2	BS	8	8	4	4			0		24 (22-28)	16.3%
3	ES	4	3	0	0			0		7 (24)	4.8%
4	PC	4	7	14	15	16	13	7		76 (48)	43.3%
5	PE					3	3	6	6	18 (18)	10.9%
6	OE					3	3	3		9	5.4%
7	EEC						3	3	8	14 (12-16)	9%
8	MC	0	0	0						0	0
Total		20	22	21	22	22	22	22	14	165	100%

HSS - Humanities and Social Sciences

BS - Basic Sciences

ES - Engineering Sciences

PC - Professional Core

PE - Professional Electives

OE - Open Electives

EEC - Employability Enhancement Courses

MC - Mandatory Courses (Non-Credit Courses)

CA - Continuous Assessment

FE - Final Examination

Passed in Board of Studies Meeting CHAIRMAN - BOARD OF STUDIES *Approved in Academic Council Meeting*

FIRST SEMESTER

23MA102	Matrices and Calculus (Common to all B.E/B.Tech Programmes)	L	T	P	C
		3	1	0	4
Nature of Course	Basic Sciences				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Introduce the concept of orthogonal transformation to convert the square matrix into diagonal form.
2. Acquaint the student with mathematical tools needed in evaluating derivatives and differentiation of one variable.
3. Familiarize the functions of two variables, Taylor series and Jacobian techniques
4. Impart knowledge of double integral techniques in evaluating volume of the solid.
5. Learn the Green's theorem, Stoke's theorem and the Divergence theorem to compute integrals

Course Outcomes

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

CO. No	Course Outcome	Bloom's Level
CO 1	Apply the concept of orthogonal reduction for diagonalization of the given matrix	Apply
CO 2	Execute the rules of differentiation to differentiate the functions.	Apply
CO 3	Demonstrate the maxima and minima for a given function with two variables	Apply
CO 4	Apply integration to compute area and volume using multiple integrals	Apply
CO 5	Interpret the Green's theorem, Stokes' theorem and Divergence theorem to evaluate integrals.	Apply

Course Syllabus

Module – I	MATRICES	12
Eigenvalues and Eigenvectors of a real matrix – Characteristic Equation- Properties - Cayley Hamilton Theorem - Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic Forms		
Module – II	DIFFERENTIAL CALCULUS	12
Functions of single Variable -Limits and Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rule) – Implicit Functions-Logarithmic functions-Maxima and Minima of function of one variable –Taylor's series		
Module – III	FUNCTIONS OF TWO VARIABLES	12
Limits and Continuity – Partial differentiation–Homogeneous functions and Euler's theorem–Jacobians–Partialdifferentiationofimplicitfunctions–Taylor'sseries– Maxima and minima – Lagrange's method of multipliers		
Module – IV	MULTIPLE INTEGRALS	12
Double integrals – Change of order of Integration- Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids		
Module – V	VECTOR CALCULUS	12
Gradient and directional derivative — Divergence and Curl — Green's, Gauss divergence and Stoke's theorems — Verification and application in evaluating line, surface and volume integrals (cube, rectangular parallelepiped).		
Total: 60 Periods		

Text Books

1. B.K.Pal and K.Das , "Engineering Mathematics", Volume-1, 10th Edition, U.N.Dhur and Sons private limited,2020
2. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, Delhi, 44th Edition, 2019.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Limited, 2018.

Reference Books

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 1st Edition, 2018
2. N.P.Bali, Manish Goyal, "A text book of Engineering Mathematics Semester II", Laxmi Publications, 6th Edition 2015.
3. Veerarajan T," Engineering Mathematics for Semester I and II", Tata McGraw Hill, 3rd Edition 2017.
4. Brian Vick, "Applied Engineering Mathematics", 1st Edition, ISBN 9780367432768,CRC Press, 2020

Additional References

1. **NPTEL-**https://nptel.ac.in/courses/111105035
2. **NPTEL**-https://nptel.ac.in/courses/111104144
3. **NPTEL-** https://nptel.ac.in/courses/111105122

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

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

Formative Assessment

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

Summative Assessment

Bloom's Category	Internal Assessment Examinations (IAE)			Final Examinations (FE)
	IAE – I (5)	IAE – II (10)	IAE – III (10)	60
Remember				
Understand				
Apply	50	50	50	60
Analyse				
Evaluate				

23HS101	தமிழர் மரபு Common to all B.E./B.Tech Programmes	L	T	P	C
		1	0	0	1
Nature of Course	Humanities and Sciences				
Pre requisites	Nil				

Course Objectives

The course is intended to

1 தமிழ் இலக்கியத்தையும் அதன் முக்கியத்துவத்தையும் எடுத்துக்கூறுதல்

2. தமிழர்களின் பாரம்பரியத்தை காட்சிப்படுத்துதல்

3. தமிழர்களின் நாட்டுப்புற மற்றும் தற்காப்புக் கலைகளின் முக்கியத்துவத்தை உணருதல்

4. தமிழர்களின் திணைக் கருத்துகளை இணைத்தல்

5. இந்திய தேசிய இயக்கத்திற்கும் தமிழ் மருத்துவத்திற்கும் தமிழர்களின் பங்களிப்பைப் பாராட்டுதல்

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1.	தமிழ் மொழி மற்றும் அதன் இலக்கியத்தின் முக்கியத்துவத்தை அடையாளம் காண்பர்	Understand
CO2.	தமிழின் பாரம்பரியத்தை மற்றவர்களிடமிருந்து வேறுபடுத்துவர்	Apply
CO3.	தமிழின் நாட்டுப்புற மற்றும் தற்காப்பு கலைகளை நிகழ்த்துவர்	Apply
CO4.	தமது வாழ்க்கை முறையை தமிழர்களின் திணை கருத்துடன் ஒப்பிட்டு அறிவர்	Apply
CO5.	இந்திய தேசிய இயக்கத்திற்கும் தமிழ் மருத்துவத்திற்கும் தமிழர்களின் பங்களிப்பைப் புரிந்துகொண்டிருப்பர்	Understand

Course Contents:

MODULE I மொழி மற்றும் இலக்கியம் **9**

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பிரதிதாசன் ஆகியோரின் பங்களிப்பு.

MODULE II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை **9**

நடுக்கல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் – நாட்டுப்புற தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

MODULE III நாட்டுப்புறக் கலைகள் மற்றும் வேற 9

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழிழர்களின் விளையாட்டுகள்.

MODULE IV தமிழர்களின் திணைக் கோட்பாடுகள் 9

தமிழகத்தின் தாவரங்களும்,விலங்குகளும் - தொல்காப்பியம் மாற்று, சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இருக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

MODULE V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 9

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம்- சுயமரியாதை இயக்கம்- இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கவெட்டுக்கள், கையெழுப்படிகள்-தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு

Total: 45 Periods

Text Books

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ் நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல்துறை வெளியீடு

Reference Books:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

20BM101	CLINICAL BIOCHEMISTRY	L	T	P	C
		3	0	0	3
Nature of Course	PC				
Pre requisites	Chemistry				

Course Objective:

The course is intended to

1. Impart knowledge on fundamentals of the structure and functions of cells and the physiological role of buffers
2. Introduce the basic concept about carbohydrates and their metabolic regulation
3. Learn the lipid metabolism in health and disease
4. Introduce the structure and function of nucleic acids and proteins
5. Gain clinical application of enzymes and hormones

Course Outcomes

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

CO. No	Course Outcome	Bloom's Level
CO1	Explain the fundamentals of biochemistry	Understanding
CO2	Analyze structural and functional aspects of living organisms	Analyse
CO3	Explain the function of microscope	Understanding
CO4	Describe methods involved in treating the pathological diseases	Understanding
CO5	Elucidate the fundamentals of microbiology	Understanding

Course Contents

Module – I	INTRODUCTION TO BIOCHEMISTRY	9
Structure of cells, functions of subcellular organells, structure and function of biological membrane, types of Biomolecules, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hasselbalch equation, physiological buffers in living systems, acidosis, and alkalosis.		
Module – II	CARBOHYDRATES	9
Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates. Digestion and absorption of carbohydrates. Regulation of blood glucose through insulin and glucagon. Hypoglycemia, biochemical aspect of diabetes mellitus, glycosylated hemoglobin, glucose tolerance test, diabetic cataract, and glycogen storage diseases.		
Module – III	LIPIDS	9
Classification of lipids - simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat. Hormonal regulation of fatty acid metabolism, disorders of lipid metabolism. Lipid profile in health and disease, glycolipid disorders, hypercholesterolemia, atherosclerosis, cholesterol stones and cholesterol lowering drugs.		
Module – IV	NUCLEIC ACID & PROTEIN	9
Structure of purines and pyrimidines, nucleoside, nucleotide, DNA as a genetic material, Chargoff" s rule. Watson and Crick model of DNA. Structure of RNA and its type. Disorder of purine and pyrimidine nucleotide, classification, structure and function of proteins, classification, and amino acids. Inborn errors of amino acid metabolism phenylketonuria, albinism, alkaptunuria, maple syrup syndrome, obesity and the metabolic syndrome, protein calorie malnutrition, hemoglobinopathies.		

Module – V	ENZYMES, HORMONES AND THEIR CLINICAL APPLICATION	9
Classification of enzymes, apoenzyme, coenzyme, holoenzyme, and cofactors. Kinetics of enzymes - Michaelis-Menten equation. Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration, Clinical enzymology, Measurement of SGOT, SGPT, LDH and interpretation of results. Hormones, peptide hormones, steroid hormones, functions of hormones, hormonal cascade, disorders of pituitary hormones, thyroid hormones and steroid hormones, hormonal assay and its significance		
		Total : 45 Periods

Text Books

1. RAFI MD "Text book of biochemistry for Medical Student" Fourth Edition, Universities Press, Orient Blackswan Private Limited - New Delhi 2021
2. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 10th edition: South Asia Edition Elsevier India, 2020.
3. Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 2017 10th edition. (Units III, IV and V).

Reference Books

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
2. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
3. Dubey RC and Maheswari DK. "A Text Book of Microbiology" Chand & Company Ltd, 2007.
4. Prescott, Harley and Klein, "Microbiology", 10th edition, McGraw Hill, 2017.

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

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

Summative Assessment				
Bloom's Category	Internal Assessment Examinations (IAE)			Final Examinations (FE)
	IAE – I (5)	IAE – II (10)	IAE – III (10)	60
Remember				
Understand	30	30	30	60
Apply				
Analyse	20	20	20	40
Evaluate				
Create				

20BM306	CLINICAL BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1
Nature of Course	Professional Core				
Pre requisites	Engineering Chemistry				

Course Outcomes

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

1. Experiment and identify the chemical and microscopic components of biological samples under different physiological conditions
2. Experiment and quantify the abnormal constituents in biological samples and interpret common result patterns related to different pathological conditions.
3. Perform physiological tests that examine the function of various components of a body system.
4. Experiment and study steady state kinetics of clinically important enzymes.
5. Use common analytical instruments in clinical laboratory

CYCLE-1

S.No.	Course Content	CO	Bloom's Level
1	Preparation of Phosphate buffers and acetate buffer	CO 1	Apply
2	Qualitative analysis of carbohydrates, reducing and non reducing sugars.	CO 1	Apply
3	Estimation of blood glucose	CO 2	Understand
4	Qualitative analysis of glucose and albumin from urine sample.	CO 2	Understand
5	Estimation of Serum Cholesterol (LDL, HDL, Triglycerides)	CO 3	Understand
6	Estimation of serum bilirubin	CO 3	Apply

CYCLE-2

S.No.	Course Content	CO	Bloom's Level
1	Estimation of salivary amylase	CO 3	Analyze
2	Estimation of alkaline phosphate	CO 3	Apply
3	Estimation of blood urea nitrogen (BUN)	CO 4	Analyze
4	Estimation of serum creatinine	CO 4	Understand
5	Qualitative analysis of aminoacids	CO 4	Analyze
6	Estimation of alanine transaminase	CO 5	Understand
7	Estimation of serum SGOT	CO5	Analyze

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

Summative Assessment						
Bloom's Level	**Continuous Assessment**					**Final Examination (Practical) (60)**
	Theory				**Practical's**	
	IAE – 1 (5)	**IAE – 2 (10)**	**IAE – 3 (10)**	**Attendance (5)**	**Rubric based CIA (60)**	
Remember						
Understand	10	20	30		20	40
Apply	10	10	10		20	20
Analyze	30	20	10		20	40
Evaluate						
Create						

Reference:

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009

23ENE01	Communicative English Common to all B.E./B.Tech Programmes	L	T	P	C
		2	0	2	3
Nature of Course	Humanities and Sciences				
Pre requisites	Nil				

Course Objectives

The course is intended to

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

Course Outcomes

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

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

Course Contents:

MODULE I BASIC GRAMMAR AND USAGE 9

Grammar: Parts of Speech – Verb (Primary & Modal Auxiliary) – Prefixes and Suffixes **Listening:** Listening Skills: Importance and Types of Listening – Barriers of Listening - Listening to short monologues **Speaking:** Introducing oneself – Role play Reading: Types of Reading – Intensive reading – Extensive Reading – Reading Comprehension **Writing:** Permission letter **(**Industrial Visit**)** – Informal letter Dialogue writing

MODULE II APPLICATIONS OF LANGUAGE SKILLS 9

Grammar: Tenses (Present, Past and Future) – Different Forms of a word – Types of Questions **Listening:** Listening strategies – Listening to Announcements **Speaking:** Likes and dislikes-Movie Reviews – **Reading:** Skimming - Scanning - Reading Newspaper and Articles **Writing:** Inviting Dignitaries – Accepting Invitation – Declining Invitation

MODULE III CONVERSATIONAL SKILLS 9

Grammar: If conditionals – Numerical Adjectives **Listening:** - Listening to Telephone calls and taking notes – Listening Lectures **Speaking:** Technical Presentation – Group Discussion **Reading:** Reading Magazines - Cloze Test **Writing:** Calling for Quotation – Complaint Letter – Process Description

MODULE IV GRAMMATICAL ACCURACY COMPETENCE 9

Grammar: Subject verb agreement – Discourse markers - One word substitution **Listening:** Listening and gap filling – Listening and Match the answers **Speaking:** Narrating Story - Asking and giving directions **Reading:** Rearranging Jumbled sentence - Note making **Writing:** Instructions – Hints Developing – Report Writing (Fire and Accident Report)

MODULE V TECHNICAL WRITING SKILLS 9

Grammar: Homophones and Homonyms - Abbreviation and Acronyms **Listening:** Listening commentaries – Listening and Summing up **Speaking:** Impromptu speech – Presentation at a

business meeting **Reading:** Reading and summarizing articles **Writing:** Paragraph Writing – Checklist – Story writing

Total: 45 Periods

Laboratory Components

S.No.	List of Exercises	CO Mapping	RBT
1	Self Introduction	1	Understand
2	Movie Review	2	Apply
3	Group Discussion	3	Apply
4	Asking and Giving Directions	4	Apply
5	Impromptu Speech	5	Apply
6	Listening to short monologues	1	Understand
7	Listening to Announcement	2	Understand
8	Listening Telephone calls	3	Understand
9	Listening and Gap Filling	4	Apply
10	Listening and Match the answers	4	Apply

Text Books

1. Rizvi, Ashraf. M, “Effective Technical Communication”, Tata McGraw Hill Publishing companyLimited, New Delhi, 2nd Edition, 2018.
2. Hewings. M, “Advanced English Grammar”, 3rd Edition, Cambridge University Press, Chennai, 9th Edition, 2019.
3. Board of Editors, “Using English – A Course book for Undergraduate Engineers and Technologists”, Orient Black Swan Private Limited, Hyderabad, 3rd Edition, 2019

Reference Books:

1. Raman M & Sangeetha Sharma, “Technical Communication”, Oxford UniversityPress, USA,13th Edition, 2018.
2. Norman Whitby, Business Benchmark – “Pre-Intermediate to Intermediate, StudentsBook”, Cambridge University Press, 1st Edition, 2006.
3. Dhanavel S. P., “English and Soft Skills”, 1stEdition, Orient Black Swan Private Limited,Hyderabad, 1st Edition, 2010.

Web References:

1. https://www.englishclub.com/grammar/
2. https://learnenglish.britishcouncil.org
3. https://www.indiabix.com/verbal-ability/questions-and-answers/
4. https://www.elllo.org
5. https://englishforeveryone.org/Topics/Reading-Comprehension.html

Course Outcomes (CO) with Programming Outcomes (PO) Programme SpecificOutcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1									1	3	1	2	2		
CO2									1	3	1	2	2		
CO3									1	3	1	2	2		

CO4									1	3	1	2	2		
CO5									1	3	1	2	2		
	3	High			2	Medium				1	Low				

Summative assessment						
Bloom'sLevel	**Continuous Assessment**					**Final Examination (Theory) [50 marks]**
	Theory Marks				**Practical**	
	IAE-I [5]	**IAE-II [10]**	**IAE -III [10]**	**Attendance [5]**	**Rubric based CIA [20 Marks]**	
Remember	-	-	-		**-**	**-**
Understand	**20**	**20**	**20**		**20**	**40**
Apply	**30**	**30**	**30**		**30**	**60**
Analyse	-	-	-		-	-
Evaluate	-	-	-		-	-
Create	-	-	-		-	-

23CH101	CHEMISTRY FOR ELECTRICAL SCIENCES (Common for ECE, EEE, BME)	L	T	P	C
		3	0	2	4
Nature of Course	Basic Science				
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. Provide knowledge about the basic principles, preparatory methods and applications of nano materials
3. Understand the fundamentals and classifications of batteries
4. Learn applications of basic concepts of electrochemistry
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	Discuss the basic principles, synthesis and applications of nanomaterials.	Understand
CO3	Discuss the basic principles and mechanism of working of batteries and fuel cells.	Understand
CO4	Illustrate the principles of electro chemical cells, EMF, electroplating and electrolysis.	Understand
CO5	Demonstrate the importance of protection of metals from corrosion.	Apply

Course Content

MODULE- I: WATER ANALYSIS AND WATER TREATMENT 9

Water analysis: Sources of water, hard water and soft water, Hardness of water, acidity, alkalinity, and pH value. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD). Water treatment: Definition, Zeolite process, Conditioning methods: internal conditioning (Phosphate, Calgon) and external conditioning (Demineralization), Desalination, Reverse osmosis (RO), Municipal Water supply- role of chlorine.

MODULE-II: NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials, Size-dependent properties, Types of nanomaterials: Definition, properties, and uses of nanoparticle, nanocluster, nanorod, nanowire and nanotube. Synthesis: Sol-Gel and laser ablation methods. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

MODULE-III: ELECTROCHEMISTRY 9

Electrode potential, Nernst equation and problems, Reference electrodes, Standard hydrogen electrode, Calomel electrode, Ion selective electrode, Measurement of pH by glass electrode, Electrochemical series, Electrochemical cell, Galvanic cell: measurement of EMF.

MODULE -IV: ENERGY STORAGE DEVICES 9

Batteries: Definition, characteristics and classification, Primary battery: Alkaline battery, Secondary battery: lead acid battery, lithium-ion and lithium phosphate battery, Fuel cells: construction and working of H2-O2fuel cell.

MODULE-V: CORROSION AND ITS CONTROL **9**

Corrosion: Classification, Types: Chemical corrosion and Electrochemical corrosion. Corrosion control: Corrosion inhibitors, cathodic protection (sacrificial anodic protection, impressed current cathodic protection), Protective coating, Paint-Constituents and Electroplating-Chrome plating

Total: 45 Periods

Laboratory Component

S.No.	Name of the Experiment	CO Mapping	BT
1	Determination of hardness of water.	1	Apply
2	Determination of chloride content in water sample.	1	Apply
3	Conductometric titration of strong acid versus strong base.	3	Apply
4	Determination of strength of HCl by pH metry.	3	Apply
5	Estimation of copper in brass by EDTA method.	2	Apply
6	Determination of rate of corrosion by weight loss method	2	Apply
7	Estimation of strength of iron by potentiometric titration	2	Apply
8	Determination of strength of acids in a mixture of acids using conductivity meter	3	Apply

Total Periods: 15

TEXT BOOKS

1. Dr. A. Ravikrishnan, “Engineering Chemistry” Sri Krishna Hitech Publishing Company, Chemistry, 2021.
2. Ushamani M George KE, Rani Joseph, “A Textbook of Engineering Chemistry”,2021.
3. Dr. Sunita Rattan. Publisher, S.K. Kataria & Sons, Reprint, 2020.

REFERENCE BOOKS

1. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.
2. B.S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Text book of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
3. Monica Jain P. C. Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company, 17th Edition, 2019

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

Summative Assessment						
Bloom’s Level	Continuous Assessment					Final Examination (Theory) [50]
	Theory				Practical’s	
	IAE-I [5]	IAE-II [10]	IAE-III[10]	Attendance [5]	Rubric based CIA [50]	
Remember	25	20	20		-	30
Understand	15	25	25		40	60
Apply	10	5	5		60	10
Analyze	-	-	-		-	

Evaluate	-	-	-		-	
Create	-	-	-		-	

		L	T	P	C
23MC101	**Induction Programme**	2	0	0	0
Nature ofCourse	Mandatory, Non-Credit				
Pre requisites	Completion of Schooling at Higher Secondary Level				

Course Objectives

The course is intended to

1. To nurture the character and behaviour as a student.
2. To have broad understanding of society and relationships.
3. To impart interpersonal and softskills.
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

Mapping of COs with POs and PSOs

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

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

Second Semester

23BM201	MEDICAL PHYSICS	L	T	P	C
		3	0	0	3

Nature of Course	Professional core
Pre requisites	Physics for Electrical Sciences

Course Objectives

The course is intended to

1. Study principles and effects of ionizing and non-ionizing radiation in human body
2. Deliberate the physics of Dosimeter concepts and its basic radiation quantities
3. Explore the effects of radiation in biological matter and their effects in radiobiology
4. Appreciate interaction of radiations with Somatic and Genetics biological subjects
5. Comprehend various optical properties of tissue for non-invasive study

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1.	Interpret about ionization, non-ionizing radiation, its interaction with tissue.	Understand
CO2.	Define and compare impact of doses including its random effects	Apply
CO3.	Summarize fundamentals of biological effects of radiations used for tumour eradication	Understand
CO4.	Explain the fundamentals of Somatic and Genteic effects of radiations	Apply
CO5.	Illustrate the methods of Tissue optics for treatment of skin disorders	Apply

Course Contents

UNIT I IONIZATION AND NON-IONIZING RADIATION AND ITS MEDICAL APPLICATION 9

Tissue as a leaky dielectric - Relaxation processes, Debye model, Cole– Cole model, Overview of ionization- Ionization effects for Neoadjuvant chemotherapy.Non-ionizing radiation effects- Specific Absorption Rate [SAR]-Low Frequency Effects- Higher frequency effects- effects of UV and microwave - Phototherapy - PUVA (Photochemotherapy)

UNIT II DOSIMETRIC CONCEPTS AND BASIC RADIATION QUANTITIES 9

Different radiation Unit, Roentgen, gray, Sievert -Exposure-Inverse square law-KERMA- Kerma and absorbed dose–Effective Dose-stopping power -Tissue relationship between the dosimetric quantities - Bremsstrahlung radiation, Bragg's curve-concept of LD 30/50-Stochastic and Non-stochastic effects

UNIT III BIOLOGICAL EFFECTS OF IONIZING RADIATION 9

Cell survival parameters – in vitro and in vivo experiments on mammalian cell systems -Action of radiation on living cells - Target theory - single hit and multi hit target theory - other theories of cell inactivation - concepts of micro dosimetry - direct and indirect action - Radiolysis of water -radicals and molecular products - cellular effects of radiations - in activations - division delay - Tumor growth kinetics -rational of fractionation - problem of hypoxic compartment and quiescent cells - radiobiology of malignant neoplasm

UNIT IV SOMATIC, GENETIC EFFECTS OF RADIATION AND ITS RADIOSENSITIVITY 9

RBE [Relative Biological Effectiveness]- response - modifiers - LET, oxygen, cell stage - Bergonis - Tribondeau law - radio sensitivity protocol of different tissues in human LD50/30 - effect of radiation on skin - blood forming organs, lenses of eyes, embryo, digestive tract, endocrine glands, gonads, dependence of effect on dose, dose rate, type and energy of radiation syndrome - effects of chronic exposure to radiation - radiation carcinogenesis - shortening of life span - risk estimates. Threshold and linear dose - effect relationship - factors affecting frequency of radiation induced mutations recessive and dominant mutations - gene controlled hereditary diseases

UNIT V TISSUE OPTICS 9

Structure of cells and tissues – light-matter interaction: absorption, scattering, reflection, refraction, luminescence, interference, polarization; their physical models and mechanisms. Specific features of

living tissues from the point of optics. Skin pigments (melanin, bilirubin, carotene, hemoglobin) and their spectra - Composition of blood. Spectral properties of erythrocytes, thrombocytes, and blood plasma - Differences between oxygenated and deoxygenated hemoglobin absorption spectra.

Total: 45 Periods

TEXT BOOKS:

1. Gopal B. Saha, “Physics and Radiobiology of Nuclear Medicine”, 4th Edition, Springer, 2013.
2. John R Cameran, James G Skofronick “Medical Physics” John-Wiley & Sons. 1978
3. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, “Medical Physics and Biomedical Engineering”, 2nd Edition, IOP Publishers.2001.
4. W.J. Meredith and J.B. Massey “Fundamental Physics of Radiology” Varghese Publishing house. 1992

REFERENCES:

1. F M Khan-Physics of Radiation Therapy, 3rd Edition, Liippincott Williams & Wilkins, USA, 2003.
2. W. R. Hendee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 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**	
CO1	3					3				3					
CO2	3	2													
CO3	3			3		2		3			3				
CO4			2						2		2	3			
CO5			3	3					3			2			
	3	High				2	Medium				1	Low			

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

Summative Assessment				
Bloom’s Category	**Continuous Assessment**			**Final Examination (Theory) (60)**
	IAE 1 (5)	**IAE 2 (10)**	**IAE 3 (10)**	
Remember	10	10	10	10
Understand	10	10	10	20
Apply	20	10	20	40
Analyse	10	20	10	30
Evaluate	0	0	0	0
Create	0	0	0	0

23BM202	HUMAN ANATOMY AND PHYSIOLOGY	L	T	P	C
		3	0	0	3
Nature of Course	Professional core				
Pre requisites	Basics of Biology				

Course Objectives

The course is intended to

1. Know basic structural and functional elements of human body – cells and Tissues
2. Learn organs and structures involving in skeletal, Muscular, and Respiratory system formation and functions
3. Understand structure and functions of the Cardiovascular systems of human body.
4. Demonstrate anatomical features and physiology of Nervous, Endocrine Systems and Sense Organs of human systems
5. Explore anatomical features and physiology of Digestive and Excretory System

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Explain basic structure and functions of cell including special tissues	Understand
CO2	Describe anatomy and physiology of skeletal, Muscular, and Respiratory systems of human body	Understand
CO3	Identify all components of Cardiovascular systems in the human body.	Understand
CO4	Explain organs and structures involving in Nervous, Endocrine Systems and Sense Organs formation and functions.	Understand
CO5	Comprehend human digestive and excretory system functional aspects	Understand

Course Syllabus:

UNIT I CELL AND TISSUE STRUCTURE **9**

Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport of Across Cell Membrane - Action Potential – Cell to Cell Signaling - origin of cell membrane potential. Types of Specialized tissues – Functions

UNIT II SKELETAL, MUSCULAR AND RESPIRATORY SYSTEMS **9**

Skeletal - Types of Bone and function – Physiology of Bone formation – Division of Skeleton – Types of joints and function – Types of cartilage and function. Muscular: Parts of Muscle – Movements. Respiratory: Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration

UNIT III CARDIOVASCULAR SYSTEM **9**

Blood composition-functions of blood–functions of RBC. WBC types and their functions. Blood groups – importance of blood groups – identification of blood groups. Blood vessels- Structure of heart – Properties of Cardiac muscle – Conducting system of heart – Cardiac cycle – ECG - Heart sound - Volume and pressure changes and regulation of heart rate –Coronary Circulation. Factors regulating Blood flow.

UNIT IV NERVOUS AND ENDOCRINE SYSTEMS AND SENSE ORGANS **9**

Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain: Parts of Brain – Spinal Cord – Tract and Pathways of Spines – Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. Endocrine - Pituitary and thyroid gland, Sense Organs: Eye and Ear

UNIT V DIGESTIVE AND URINARY SYSTEMS **9**

Digestive: Organs of Digestive system – Digestion and Absorption. Urinary: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System – Urinary reflex

Total: 45 Periods

TEXT BOOKS:

1. Prabhjot Kaur," Text Book of Anatomy and Physiology" Lotus Publishers. 2014
2. Elaine.N. Marieb, "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi, 2007

REFERENCES:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Pearson Publishers, 2014
2. Gillian Pocock, Christopher D. Richards, The human Body – An introduction for Biomedical and Health Sciences, Oxford University Press, USA, 2013
3. William F. Ganong, "Review of Medical Physiology", 22nd Edition, Mc Graw Hill, New Delhi, 2010
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B. Saunders Company, 2015
5. Guyton & Hall, "Medical Physiology", 13th Edition, Elsevier Saunders, 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**	
CO1								2			3		3	2	
CO2	2					2		2	1			2	3	2	
CO3								2			2		3	2	
CO4	1					3		3	3			3	3	2	
CO5	1	1				3		3	2			3	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**			**Examination (25)**
	IAE-1 (5)	**IAE-2 (10)**	**IAE-3 (10)**	
Remember	15	15	15	15
Understand	35	35	35	35
Apply				
Analyze				
Evaluate				
Create				

23BM203	HUMAN PHYSIOLOGY LABORATORY	L	T	P	C
		0	0	2	1
Nature of Course	Professional core				
Pre requisites	Co-course for Human Anatomy and Physiology				

LIST OF EXPERIMENTS

S.No.	Course Content	CO	Bloom's Level
1	Collection of Blood Samples (Study experiment)	CO 1	Understand
2	Identification of Blood groups (ABO with Rh factor)	CO 3	Understand
3	Bleeding and Clotting time of blood	CO 3	Apply
4	Estimation of Hemoglobin in blood	CO 3	Apply
5	Calculate the amount of Total RBC [Red Blood Cells] Count present in the blood	CO 3	Apply
6	Calculate the amount of Total WBC [White Blood Cells] Count present in the blood	CO 3	Apply
7	Differential count of Blood cells	CO 3	Apply
8	Estimation of ESR [Erythrocyte Sedimentation Rate]	CO 3	Apply
9	Calculate the amount of PCV [Packed Cell Value], MCH [Mean Corpuscular Hemoglobin], MCV [Mean Corpuscular volume (MCV)], MCHC [Mean Corpuscular Hemoglobin Concentration] present in blood sample	CO 3	Analyze
10	Hearing test – Tuning fork	CO 4	Apply
11	Visual Activity – Snellen's Chart and Jaeger's Chart	CO 4	Apply
12	Analysis of Urine sample	CO5	Analyze

23MA302	PROBABILITY AND STATISTICS (Common to AIDS, BME, CSBS, CSE, IT & M.TECH. CSE)	L	T	P	C
		3	0	2	4
Nature of Course	Basic Sciences				
Pre requisites	Foundation of Mathematics				

Course Objectives

The course is intended to

1. Learn the fundamental concepts of random variables.
2. Acquire essential knowledge of random variables necessary for subsequent studies in digital communication.
3. Develop an understanding of hypothesis testing for both small and large samples.
4. Familiarize students with the basic concepts of experimental design types used in engineering.
5. Study classification types and principles of statistical quality control.
6. Utilize statistical methods to analyze data, infer patterns, and make informed decisions.

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1	Construct the concepts of a random variables and Probability distributions.	Apply
CO2	Examine the functions of multiples random variable.	Apply
CO3	Implement hypothesis testing techniques for small and large samples.	Apply
CO4	Predict the design of experiments in the field of engineering by the concept of classification..	Apply
CO5	Identify the sampling distribution and statistical techniques	Apply
CO6	Utilize data infer patterns and mastery in statistical reasoning and application.	Apply

Course Contents:

MODULE - I	UNIVARIATE RANDOM VARIABLES	9
Random Variables – Discrete & Continuous random variables – Probability distributions – Discrete Probability Distributions: Binomial and Poisson probability distributions – Continuous Probability Distributions: Uniform and Exponential Probability distributions.		

MODULE - II	**BIVARIATE RANDOM VARIABLES**	**9**
Joint distributions – Marginal distributions – Covariance – Correlation Coefficient - linear regression – Central limit theorem (Statement only).		
MODULE - III	**STATISTICAL HYPOTHESIS TESTING**	**9**
Distribution of samples – Parameter Estimation – Statistical hypothesis – Large sample tests relying on Normal distribution for individual mean and mean difference - Test utilizing t for mean - Chi-square test for Goodness of fit.		
MODULE - IV	**EXPERIMENTAL DESIGN AND ANALYSIS**	**9**
One way and two way classifications – Completely randomized design – Randomized block design – Latin square design.		
MODULE - V	**STATISTICAL QUALITY CONTROL**	**9**
Control charts for measurements (Mean and Range charts) – Control charts for attributes (p, c and np charts) – Tolerance limits – Acceptance sampling.		
		Total: 45 Periods

Text Books:

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 5th Edition, 2018.
2. Oliver.C.Ibe, 'Fundamentals of Applied Probability and Random Processes'', Elsevier India, 3rd Edition, 2021.
3. Freund John, E and Miller, Irvin, "Probability and Statistics for Engineering", Prentice Hall, 5th Edition2022.

Reference Books:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Lakshmi Publications Pvt Ltd, 10th Edition, 2020.
2. Ronald E. Walpole, Raymond H. Myersand Sharon L. Myers "Probability and Statistics for Engineers and scientists ", Pearson India ,14th Edition, 2021.
3. Jay L.Devore," Probability and Statistic for Engineering and the Sciences", Cengage Learning, 10th Edition, 2021.

Additional References:

1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. https://onlinecourses.swayam2.ac.in/cec21_ma02/preview
3. https://onlinecourses.nptel.ac.in/noc22_mg31/preview
4. https://onlinecourses.nptel.ac.in/noc20_ge05/preview

Laboratory Components using MATLAB:

S.No.	List of Experiments	CO Mapping	RBT
1	Poisson distribution	1	Apply
2	Uniform distributions	1	Apply
3	Marginal Distributions	2	Apply
4	Correlation Coefficient	2	Apply
5	Individual mean by Student's t - test	3	Apply
6	Goodness of fit by Chi – Square test	3	Apply
7	One way classification	4	Apply
8	Two way classification	4	Apply
9	Control Chart for Variables using Mean Chart	5	Apply
10	Control Chart for Variables using Range Chart	5	Apply

Total: 30 Periods

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

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

Bloom's Level	Summative Assessment						
	Continuous Assessment						Final Examination (Theory) [50]
	Theory			Practical			
	IAE I (5)	IAE II (10)	IAE III (10)	Attendance [5]	Rubric based [10]	Model Exam [10]	
Remember	10	10	10				10
Understand	10	10	10		40	40	30
Apply	30	30	30		60	60	60
Analyze							
Evaluate							

23BM301	Fundamentals of Bioinformatics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Human Anatomy and Physiology				

Course Objectives

The course is intended to

1. Retrieve information on genes and proteins from biological and genomic databases
2. Identify promoters and regulatory elements in DNA and protein sequences
3. Recognize Multiple Sequence Alignment methods and Profiling concept
4. Compare protein and DNA sequences
5. Study of the evolutionary development of groups of organisms by Phylogenetic Reconstruction techniques.

Course Outcomes

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

CO. No	Course Outcome	Bloom's Level
CO 1	Ability to study bioinformation infrastructure and retrieve information from biological databases	Understand
CO 2	Perform Operations on Nucleotide and Protein Sequences	Apply
CO 3	Explore possibilities to implement multiple alignment method to develop and build profiles for biological sequences	Apply
CO 4	Investigate characteristics about DNA and structure of Proteins using Markov Chain model	Analyze
CO 5	Construct and interpret simple phylogenies for evolutionary study	Apply

Course Contents

Module – I	INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES	9
History of Bioinformatics-Computational Biology Vs Bioinformatics and bioinformation infrastructure-Different verticals in Bioinformatics-Molecular Biology-DNA Sequencing-Biological Databases-Nucleotide, Protein Sequence, Pattern Databases. Information Retrieval from Databases		
Module – II	**PROCESSING BIOLOGICAL SEQUENCES**	**9**
Sequence Acquisition- Operations on Nucleotide Sequences- Joining Exons-Case Study. Restriction Site Detection. Sequence Homology- Sequence Alignment and Types - Dynamic Programming Algorithm- Pairwise Alignment & Database Searching-BLAST, FASTA. Protein Alignments- Scoring Matrices- PAM Scoring Matrix- BLOSUM Matrix		
Module – III	**MULTIPLE SEQUENCE ALIGNMENT AND TOOLS**	**9**

Multiple Sequence alignment (MSA) - Scoring Multiple Sequence Alignment- Mathematical Formulation for the MSA Problem- Progressive Alignment Methods- Modelling MSA as Profiles- Biolinguistics methods- Comparing k-mer Profiles- Sequence Comparison- Weighted Profiles		
Module – IV	**BIOLOGICAL SEQUENCE ANALYSIS**	**9**
DNA Sequence Models- Independent Identically Distribution (IID)- Markov Chain Model- Matrix Association Regions- Subsequence Pattern Models- Regular Expressions-Weight Matrices BLOSUM and Position Specific Scoring Matrix, (PSSM)		
Module – V	**PHYLOGENETICS AND SYSTEMS BIOLOGY**	**9**
Phylogeny Basics- Phylogenetic Reconstruction – Terminology- Types of Trees- Counting Phylogenetic Trees- Comparing Phylogenetic Trees- Significance of Trees Constructed- Bootstrapping- distance based phylogeny- Unweighted Pair Group Method Averages [UPGMA]- Neighbor Joining Algorithm		
		Total: 45 Periods

Text Books

1. Gautam B. Singh “Fundamentals of Bioinformatics and Computational Biology- Methods and Exercises in MATLAB”, Springer International Pub, Switzerland (2015)

Reference Books

1. Jin Xiong “Essential Bioinformatics” Cambridge University Press (2006)
2. Marketa J. Zvelebil, Jeremy O. Baum “Understanding Bioinformatics”, Garland Science (2007)

Additional References

1. https://www.ncbi.nlm.nih.gov/guide/all/
2. https://bioscience.iita.org/basics-of-bioinformatics/
3. https://www.nihlibrary.nih.gov/online-bioinformatics-tools
4. https://www.intechopen.com/chapters/50934

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

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

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

	Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE) 25 Marks**				**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**Internal Marks (40)**	**60**
Remember					
Understand	5	5	5		15
Apply	25	25	25		45
Analyse	20	20	20		40
Evaluate					
Create					

23BM302	ELECTRONIC DEVICES AND CIRCUITS	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. Familiarize the basic concepts of PN junction diode and special diodes
2. Study the characteristics of Bipolar Junction Transistors and Field Effect Transistors
3. Recognize the operation of Pulse and wave shaping circuits for biological aspects
4. Explore about operational amplifiers and its characteristics with biomedical applications
5. Introduce the basic concepts of power electronic devices and various power supplies

Course Outcomes

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

CO. No	Course Outcome	Bloom's Level
CO1	Explain the characteristics of PN junction diode and Zener diode	Understand
CO2	Interpret the construction, operation and characteristics of BJT, FET and other power electronics devices	Understand
CO3	Identify and design a suitable wave shaping circuits and Oscillator for a given biomedical specification	Apply
CO4	Summarize the performance of operational amplifier with its applications	Apply
CO5	Explore characteristics of power electronics and DC power supply.	Apply

Course Contents

Module – I	PN JUNCTION DEVICES	9
PN junction diode–structure, operation and V-I characteristics, Diode clampers and clippers, Rectifiers-Half Wave and Full Wave Rectifier, Zener diode-characteristics-Zener Reverse characteristics – Zener diode as voltage regulator.		
Module – II	**BIPOLAR TRANSISTORS AND FIELD EFFECT DEVICES**	**9**
BJT-Classification, structure, operation, characteristics, biasing, amplifier and switch, JFET- Types, structure, operation, characteristics, biasing, MOSFET- Types, structure, operation, characteristics, and biasing.		
Module – III	**PULSE AND WAVE SHAPING CIRCUITS**	**9**
Voltage series feedback, RF power amplifiers for medical applications, Crystal oscillator for wearables- structure and operation, Basic principles of RC, LC oscillators. Pulse Circuits: Pulse shaping using RC circuits- Differentiating and integrating circuits		
Module – IV	**OPERATIONAL AMPLIFIER AND ITS APPLICATIONS**	**9**
Operational amplifier-characteristics, Performance Parameters-Inverting / Non-inverting Amplifiers. Voltage Follower, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier for biomedical applications. Low pass, High pass and band pass filters, Comparator, Multivibrator and Schmitt trigger for biomedical related use cases		

Module – V	**SPECIAL ELECTRONIC DEVICES AND POWER SUPPLY**	**9**
IGBT-structure and characteristics, Thyristors - (SCR, DIAC, TRIAC, UJT)-structure and operation. Design of DC Power Supply with Battery backup -Voltage Regulators –DC-DC Converter- Linear and Switched types- SMPS- Basics of HT Power supply for x-ray machines		
		Total: 45 Periods

Text Book:

1. David A. Bell, “Electronic Devices and Circuits”, 6th Edition, Oxford University Press, 2009.
2. D. Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International ,2000.

Reference Books:

1. Thomas L. Floyd, “Electronic devices” Prentice Hall”, 10th Edition, 2018
2. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson Education, 2015.
3. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, 3rd Edition, Tata McGraw-Hill, 2007.
4. G.K.Mithal, “Electronic devices and circuits”, Khanna Publishers, 2010.

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

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	10	
Apply			
	Attendance	0	

Summative Assessment		
Bloom’s Category	**Internal Assessment Examinations (IAE)**	**Final Examinations (FE)**

	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember				
Understand	30	30	30	60
Apply	20	20	20	40
Analyse				
Evaluate				
Create				

23BM303	SIGNALS AND SYSTEMS FOR BIOENGINEERS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Engineering Mathematics				

Course Objectives

The course is intended to

1. Understand the classification of Biosignals and Physiological systems with its properties.
2. Investigate CT signals using Fourier series & Transforms in Time domain.
3. Appraise DT signals and systems using Fourier transform and Z-Transform.
4. Examine concurrent, Coupled and Correlated Physiological Processes.
5. Comprehend Joint Time Frequency [JTF] concepts to Biosignal applications.

Course Outcomes

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

CO.No	Course Outcome	Bloom's Level
CO 1	Explain the basic concepts of Biosignals and Physiological Systems with its Characteristics	Understand
CO 2	Investigate Analog CT signals and systems with Fourier series, CTFT including Laplace Transform for LTI Analog System Analysis	Analyze
CO 3	Explore Discrete DT signals and systems using Fourier transform, DTFT and Z-Transform for LTI Discrete System Analysis	Analyze
CO 4	Examine Concurrent, Coupled and Correlated Physiological Process with examples for event detection in Biomedical applications	Apply
CO 5	Interpret Joint Time Frequency [JTFA] Concepts for Biosignal interpretation and Classification	Apply

Course Contents

Module – I CLASSIFICATIONS OF BIOSIGNALS AND PHYSIOLOGICAL SYSTEMS 9

Basics of Biosignals and Physiological Systems – Characteristics and representation of Biosignals- Continuous time (CT) signals – discrete time(DT) signals – Impulse, Step, Ramp, Exponential, Pulse– Transformation of the independent variable – Classification, properties and basic operations of CT and DT signals – CT systems and DT systems – Basic system properties – Linear Time invariant (LTI) Systems and properties- Stability and Feedback Physiological Systems-Multi-input Multi-output [MIMO] Systems.

Module – II FOURIER SERIES REPRESENTATION AND ANALOG LTI SYSTEMS 9

Fourier Series representation of CT periodic signals – Properties – Representation of Analog system by differential equation – Convolution integral and Properties – Impulse response of Interconnected systems - Signal Averaging for Noise elimination-SNR-Analog Filters- The Analog Transfer Function and Laplace Transform – Inverse Laplace Transform – Properties – Analysis of Biological Examples for LTI Systems using Laplace Transform- DTFT and properties.

Module – III FOURIER TRANSFORM, Z-TRANSFORM AND DIGITAL LTI SYSTEMS 9

Sampling – Quantization- Spectrum of Sampled Signal by Fourier Transform – Reconstruction - Difference equation representation of Digital system– Convolution operation & Properties – Impulse response of Interconnected systems – DFT and properties. The Digital Transfer Function and the Z–Transform – Inverse Z–Transform – Properties – Analysis of Biological Examples LTI Systems using Z–Transform- Digital Filters.

Module – IV ANALYSIS OF CONCURRENT, COUPLED, AND CORRELATED PROCESSES 9

Illustration of the Problem with Physiological Case Studies-The ECG and the PCG interpretation -The importance of HRV [Heart Rate Variability]- The knee joint and muscle vibration signals-The Pan–Tompkins algorithm for QRS detection Theory & Concepts.

Module – V JOINT TIME-FREQUENCY ANALYSIS OF BIOMEDICAL SIGNALS 9

Introduction to Joint Time Frequency Analysis (JFTA) Using Wavelets - Applications of JTFA to Physiological Signals – Heart Sound, Murmurs Analysis for congenital heart diseases.

Total: 45 Periods

Text Books

1. Allan V.Oppenheim, S.H.Nawab, “Signals and Systems”, Pearson Education, 2015.
2. Robert A. Gabel and Richard A. Roberts, “Signals & Linear Systems”, 3rd Edition, John Wiley, 2009
3. John Semmlow," Signals and Systems for Bioengineers" Elsevier India Private Limited, 2012
4. Rangayyan M. Rangaraj, “Biomedical Signal Analysis” 2nd Edition-Wiley (2015)
5. Robert B. Northrop” Signals and Systems Analysis in Biomedical Engineering”2nd Edition,2010 CRC Press

Reference Books

1. H P Hsu and Rakesh Ranjan, “Signals and Systems, Schaum’s Outlines”, 2nd edition, Tata McGraw Hill, 2017
2. S.Salivahanan, “Digital Signal Processing”, 3rd Edition, McGraw Hill International/TMH, 2015. S Srinivasan, “Automotive Mechanics”, McGraw Hill Education; 2nd edition July 2017
3. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
4. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems -Continuous and Discrete”,Pearson, 2007.

Additional References

1. **http://users.ece.gatech.edu/~bonnie/book/worked_problems.html**
   http://www.ece.jhu.edu/~cooper/courses/214/signalsandsystemsnotes.pdf

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

COs	PO’s												PSO’s	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 6	2	3	3	3	2						1	2	2	1
CO 7	2	3	3	3	2						1	2	2	1
CO 8	2	3	3	3	2						1	2	2	1
CO 9	2	3	3	3	2						1	2	2	1
CO 10	2	3	3	3	3						1	2	2	1
	3-High				2-Medium				1- Low					

CHAIRMAN - BOARD OF STUDIES

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	10	
Apply			
	Attendance	0	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE) (40)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**(60)**
Remember				
Understand	30	30	30	60
Apply	10	10	10	20
Analyse	10	10	10	20
Evaluate				
Create				

20BM306	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2
Nature of Course	Professional core				
Pre requisites	Engineering Physics				

Course Outcomes

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

1. Perform and infer V-I characteristics of PN junction and Zener diode
2. Demonstrate the construction, operation and characteristics of BJT and FET
3. Design and experiment the frequency response of amplifiers and oscillators
4. Ability to apply operational amplifier for biomedical domain
5. Establish the significance of multivibrators using operational amplifiers

CYCLE-1

S.No.	Course Content	CO	Bloom's Level
1	Practical Verification of superposition theorem and Maximum power transfer theorem	CO 1	Apply
2	Construct and testing of half wave and full wave rectifiers circuit using PN Junction Diode	CO 1	Apply
3	Conduct the experiment of Characteristics of Zener Diode application as voltage regulator	CO 1	Understand
4	Determine the BJT and FET Characteristics	CO 2	Understand
5	Perform the Frequency Response of CE Amplifier	CO 3	Understand
6	Design of RC Oscillators and LC Oscillators using BJT	CO 3	Apply

CYCLE-2

S.No.	Course Content	CO	Bloom's Level
1	Design of Inverting, non-inverting amplifier and comparator	CO 4	Analyze
2	Design and verify the output of Integrator and Differentiator	CO 4	Apply
3	Measure the threshold point of Schmitt trigger using operational amplifier	CO 4	Understand
4	Design Instrumentation amplifier using operational amplifier	CO 4	Analyze
5	Measure the frequency of oscillation of Multivibrators using operational amplifier	CO 5	Understand

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

Assessment based on Continuous and Final Examination			
Bloom's Level	**Continuous Assessment (60 marks) (Attendance – 0 marks)**		**Final Examination [40 marks]**
	Rubric based Continuous Assessment [40 marks]	**Model Examination [20 marks]**	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyze			
Evaluate			
Create			

23MA401	NUMERICAL METHODS (Common to AIDS ,BME, CSBS, CSE, ECE, EEE, IT and M.Tech CSE)	L	T	P	C
		3	0	2	4
Nature of Course	Basic Sciences				
Pre requisites	Foundations of Mathematics				

Course Objectives

The course is intended to

1. Introduce the basic concepts of algebraic and transcendental equations.
2. Indicate the Numerical techniques of interpolation in various intervals.
3. Learn the concept of numerical techniques of differentiation and integration.
4. Study the numerical techniques in solving ordinary differential equations.
5. Provide the Numerical techniques in solving one dimensional and two dimensional heat equations.
6. Acquire proficiency in employing computational techniques to solve mathematical problems efficiently and accurately.

Course Outcomes

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

Co. No.	Course Outcome	Bloom's Level
CO1	Demonstrate the algebraic and transcendental equations.	Apply
CO2	Perform the numerical techniques of interpolation and error approximations in various Intervals**.**	Apply
CO3	Compute the numerical techniques of differentiation and integration for engineering problems.	Apply
CO4	Classify the numerical techniques for solving first order ordinary differential equations.	Apply
CO5	Illustrate the solution of boundary value problems.	Apply
CO6	Utilize computational techniques to solve mathematical problems efficiently and accurately.	Apply

Course Contents:

Module – I	SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS	9
Solution of Algebraic and Transcendental equations – Newton - Raphson method- Solution of linear system of equations -Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi method and Gauss Seidel method.		
Module – II	**INTERPOLATION AND APPROXIMATION**	**9**

	Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Interpolation with equal intervals – Newton's interpolation formulae.

Module – III	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9**
	Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 rules – Two point and three point Gaussian quadrature formulae.	
Module – IV	**NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS**	**9**
	Single step methods: Euler's method – Fourth order Runge - Kutta method for solving first order equations – Shooting Method – Multi step methods: Milne's predictor corrector methods for solving first order equations.	
Module – V	**BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS**	**9**
Finite difference techniques for the solution of two dimensional Laplace's equations on rectangular domain – One dimensional heat flow equation – Bender Schmidt method by explicit – Crank Nicholson methods.		
		Total: 45 Periods

Text Books:

1. Grewal B.S, and Grewal J.S, '' Numerical methods in engineering and science "Khanna Publishers, 10th Edition, 2015.
2. Burden, R.L. and Faires, J.D, "Numerical Analysis" Cengage Learning, 9th Edition, 2016.
3. Gupta, S.K., "Numerical Methods for Engineers", New Age Publishers, Third Edition, 2015.

Reference Books:

1. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, New Delhi, 4th Edition, 2017.
2. Sastry, S.S., "Introductory Methods of Numerical Analysis", PHI Learning pvt Ltd, 5th Edition, 2015.
3. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., "Computational Methods for Partial Differential Equations", New Age Publishers, 2016.
4. Curtis F.Gerald, Patrick.O. Wheatley, "Applied Numerical Analysis", Pearson Education, 8th Edition, 2022.

Additional References:

1. https://nptel.ac.in/courses/111/107/111107105
2. https://nptel.ac.in/courses/127/106/127106019
3. https://archive.nptel.ac.in/content/storage2/courses/122104018/node126.html

Laboratory Components using MATLAB:

S.No	List of Excercises	CO Mapping	RBT
1	Gauss Elimination Method	1	Apply
2	Gauss Seidel Method	1	Apply
3	Lagrange's Interpolation Formula	2	Apply
4	Newton's Forward and Backward difference formula	2	Apply
5	Trapezoidal Rule	3	Apply
6	Simpson's 1/3 rd rule	3	Apply
7	Euler's Method	4	Apply
8	Runge – Kutta Method	4	Apply
9	Finite Difference Method	5	Apply
10	Bender Schmidt method	5	Apply

Total: 30 Periods

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

	POs												PSOs		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	-	-	-	-	-	-	-	-		2		
CO2	3	2	2	-	-	-	-	-	-	-	-		2		
CO3	3	2	1	-	-	-	-	-	-	-	-		2		
CO4	2	2	1	-	-	-	-	-	-	-	-		1		
CO5	3	3	1	-	-	-	-	-	-	-	-		2		
CO6	3	2	2	-	-	-	-	-	-	-	-		2		
	3	High				2	Medium					1	Low		

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

23BM401	Digital Electronics and Integrated Circuits	L	T	P	C
		3	2	0	4

Nature of Course	Professional Core
Pre requisites	Electronic device

Course Objectives

The course is intended to

1. Understand the digital fundamentals, Boolean algebra and its applications in digital systems
2. Design the various combinational digital circuits using logic gates
3. Introduce the analysis and design procedures for synchronous sequential circuits
4. Study the various semiconductor memories and integrated circuits
5. Understand the basic concepts of ADC and DAC

Course Outcomes

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

CO. No	Course Outcome	Bloom's Level
CO 1	Exlore Boolean theorems to minimize logic expressions in different forms and implement them using logic gates	Apply
CO 2	Design various combinational circuits using logic gates	Apply
CO 3	Design synchronous-sequential circuits for a given specification	Apply
CO 4	Investigate the characteristics and structure of different memory systems and programmable logic devices	Analyze
CO 5	Interpret the various Analog/Digital converters ADC and DAC	Understand

Course Contents

Module – I	MINIMIZATION TECHNIQUES AND LOGIC FAMILY	10
Minimization Techniques: Boolean postulates and laws – De–Morgan's Theorem – Principle of Duality – Boolean expression – Standard Form, Canonical Form, Minimization of Boolean expressions using Boolean laws and theorem – logic gates-universal gates-Sum of Products (SOP) – Product of Sums (POS) – Don't care conditions – Minimization of Boolean expressions using Karnaugh map and Quine McCluskey method. Logic families: TTL, MOS and CMOS Logic and comparison of logic families.		
Module – II	**COMBINATIONAL CIRCUIT DESIGN**	**9**
Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder- Multiplexer- Demultiplexer-Magnitude Comparator-Decoder-Encoder-Priority Encoder		
Module – III	**SYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**
Latches, Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Edge and Level Triggering of FF, Analysis and design of clocked sequential circuits minimization-Design of Counters- Asynchronous Ripple Counters-up/down counters-modulo n counters-Ring Counters-Shift registers- Universal Shift Register		
Module – IV	**MEMORY DEVICES AND PROGRAMMABLE LOGIC DEVICES**	**8**

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.		
Module – V	**ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS and PLL**	**9**
Analog and Digital Data Conversions – specifications – D/A converter– weighted resistor DAC-2R Ladder DAC-high speed sample and hold circuits – A/D Converters–Flash type–Counter Type Successive Approximation type. Voltage controlled oscillator-Voltage to Frequency converters-PLL.		
		Total: 45 Periods

Text Books

1. M.Morris Mano and Michael D.Ciletti, "Digital Design", Pearson, 5th Edition, 2018. (Unit I-IV)
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Mc Graw Hill Education, 3rd Edition, 2017 (Unit V)

Reference Books

1. Charles H.Roth, Jr, "Fundamentals of Logic Design", Jaico Books, 7th Edition, 2013
2. S.Salivahanan and S.Arivazhagan, "Digital Circuits and Design", 5th Edition, Oxford University Press, 2018.
3. A.Anand Kumar, Fundamentals of Digital Circuits, 4th Edition, PHI Learning Private Limited, 2016.

Additional References

2. http://web.iitd.ac.in/~shouri/eel201/lectures.php

3. http://www.allaboutcircuits.com/vol_4/

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

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

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	10	
Apply			
	Attendance	0	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember				
Understand	15	15	15	20
Apply	20	20	20	60
Analyse	15	15	15	20
Evaluate				
Create				

23BM402	BIOSIGNAL PROCESSING	L	T	P	C
		3	2	0	4
Nature of course	Professional Core				
Prerequisites	Signals and Systems for Bioengineers				

Course Objectives

The course is intended to

1. Understand the characteristics of biosignals like ECG, EEG, EOG, and EMG.
2. Comprehend the choice of filters to remove noise and artifacts from biosignals
3. Practice the established engineering methods to study cardiovascular signals.
4. Utilize the established engineering methods to interpret neurological signals.
5. Implement the engineering methods to explore muscular signals.

Course Outcomes

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

CO. No	Course Outcome	Bloom's Level
CO 1	Recognize various biomedical signals with spectral components.	Understanding
CO 2	Justify the suitable filter selection for noises with its performance.	Understanding
CO 3	Identify the various artifacts of the cardiovascular system through signal processing techniques.	Apply
CO 4	Perform spectral analysis on different neurological signals.	Apply
CO 5	Execute general analysis on muscular signals.	Apply

Course Contents

Module – I	INTRODUCTION TO BIOMEDICAL SIGNALS	9

Introduction to Biosignals and its Characteristics – Essential features of action potential for myocyte, neuron-Electrocardiogram (ECG/EKG)-Electroneurogram (ENG)-Electromyogram (EMG). Electroencephalogram (EEG)- Evoked Potentials (EP's)-Event-Related Potentials (ERP's) – Vibromyogram (VMG) – Vibroarthrogram (VAG). Challenges and Clinical use cases applied to Biosignal processing and analysis in deployment to patient diagnostic purpose.

Module – II	FILTER'S FOR BIOSIGNAL PROCESSING	9

Analog filter design: Ideal Filters vs Practical analog filter design methods. Digital filter design: Analog filter vs. digital filters- Introduction to Finite Impulse Response Filters (FIR)- Low-pass, High-pass, and Band-pass FIR Filter Design- Phase Response of FIR Filter-Introduction to Infinite Impulse Response Filter (IIR)- IIR filter design methods- Case study for biosignals.

Module – III	CARDIOVASCULAR APPLICATIONS	9

Salient features of Heart Rhythms- Heartbeat Morphologies- Noise and Artifacts of ECG and its Signal Processing Techniques to remove Baseline Wander, powerline interference-QRS detection and performance Evaluation- Heart Rhythm Representation-Spectral analysis applied to Heart Rate Variability measurements and quantification.

Module – IV	NEUROLOGICAL APPLICATIONS	9

Challenges of Electroencephalogram interpretation – Frequency bands of EEG Signal- Awake vs epileptic characterization and artifact reduction and Cancellation methods- Nonparametric Spectral Analysis- Model-based Spectral Analysis- Various approaches to measure Spectral Error - Joint Time-Frequency Analysis: The Short-Time Fourier Transform-The Ambiguity Function-The Wigner-Ville Distribution-Model-based Analysis of lower band EEG Signals for sleep disorders.

Module – V	MUSCULAR APPLICATIONS	9

Amplitude Estimation in the Surface EMG: Signal Model and Maximum Likelihood (ML) Estimation -Modifications of the ML Amplitude Estimator-Multiple Electrode Sites- Spectral Analysis of the Surface EMG- conduction velocity estimation- Modelling the Intramuscular EMG: A signal model of the Motor unit action potential [MUAP]train, Amplitude, and power spectrum Intramuscular EMG Signal Decomposition. Muscle bundles and twitching-revolutionizing computer use for individuals with restricted mobility

Total: 45 Periods

Text Books

1.R M Rangayyan "Biomedical Signal Analysis: A Case-Based Approach," IEEE Press, John Wiley & Sons. Inc, 2002 (Module 1)
2.Lyons, Richard G, "Understanding digital signal processing," Prentice Hall (2011) (Module 2).
3.Leif Sornmo, Pablo Laguna "Bioelectrical Signal Processing in Cardiac and Neurological Applications," Academic Press (2005) (Module 3, 4 and 5).

Reference Books

1. Eugene N. Bruce "Biomedical Signal Processing and Signal Modelling"
2. D. C. Reddy "Biomedical Signal Processing: Principles and Techniques."
3. Metin Akay "Biomedical Signal Processing"

Additional / Web References

1. https://www.bmes.org/
2. https://onlinecourses.nptel.ac.in/noc24_ee49, "Biomedical Signal Processing,"

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

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	3	2	3	2	1					2	2	3	2
CO 2	3	3	2	3	2	1					2	2	3	2
CO 3	3	3	3	2	3	2					2	2	3	2
CO 4	3	3	3	2	3	2					2	2	3	2
CO 5	3	3	3	2	3	2					2	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	10	
	Attendance	0	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations**			**Final Examination (60)**
	IAE – 1 (5)	**IAE – 2 (10)**	**IAE – 3 (10)**	
Remember	20	15	15	30
Understand	20	15	15	30
Apply	10	20	20	40
Analyze				
Evaluate				
Create				

23BM403	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

Nature of Course	Humanities and Social Sciences
Pre requisites	Code of conduct for Engineers

Course Objectives

The course is intended to

1. Learn about the healthcare environment and management
2. Study and familiarize with hospital architecture, planning and maintenance
3. Know the health care laws and ethics in healthcare
4. Recognize hospital operations management
5. Identify patient care management

Course Outcomes

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

CO. No	Course Outcome	Bloom's Level
CO 1	Ability to learn about the healthcare environment and management	Understand
CO 2	Explore the essentials of hospital architecture, planning and maintenance	Apply
CO 3	To Investigate health care laws and ethics in healthcare	Understand
CO 4	Implementation aspects of hospital operations management	Apply
CO 5	Significance of patient care management	Understand

Course Contents

Module – I	HEALTHCARE ENVIRONMENT AND MANAGEMENT	9

Overview of Health Care Sector in India – Primary care – Secondary care – Tertiary care – Rural Medical care – urban medical care – curative care – Preventive care – General & special Hospitals-Understanding the Hospital Management – Role of Medical, Nursing Staff, Paramedical and Supporting Staff - Health Policy - Population Policy - Drug Policy – Medical Education Policy. Health Care Regulation – WHO, International Health regulations, IMA, MCI, State Medical Council Bodies, Health universities and Teaching Hospitals and other Health care Delivery Systems

Module – II	HOSPITAL ARCHITECTURE, PLANNING AND MAINTENANCE	9

Hospital as a system: Definition of hospital – classification of hospitals – changing role of hospitals – role of hospital administrator – hospital as a system – hospital & community.

Planning: Principles of planning – regionalization - hospital planning team – planning process – size of the hospital – site selection – hospital architect – architect report – equipping a hospital – interiors & graphics – construction & commissioning – planning for preventing injuries –electrical safety- Assessment of the demand and need for hospital services – factors influencing hospital utilization – bed planning – land requirements – project cost – space requirements –hospital drawings & documents-preparing project report.

Hospital standards and design: Building requirement – Entrance & Ambulatory Zone –

Diagnostic Zone – Intermediate Zone – Critical zone – Service Zone – Administrative zone – List of Utilities – Communication facility – Biomedical equipment - Voluntary & Mandatory standards – General standards – Mechanical standards – Electrical standards – standard for centralized medical gas system – standards for biomedical waste		
Module – III	**HEALTH CARE LAWS AND ETHICS**	**9**
Laws relating to Hospital formation: Promotion-Forming society-The Companies Act-Law of Partnership-A Sample Constitution for the Hospital-The Tamil Nadu Clinics Act – Medical Ethics -Laws relating Purchases and funding: Law of contracts-Law of Insurance-Export Import Policy-FEMA-Exemption of Income Tax for Donations-Tax Obligations: Filing Returns and Deductions at Source. Laws pertaining to Health: Central Births and Deaths Registration Act, 1969- Recent amendments – Medical Termination of Pregnancy Act, 1971 – Infant Milk Substitutes, Feeding Bottles and Infant Food Act, 1992. Laws pertaining to Hospitals: Transplantation of Human Organs Act, 1994 – Pre-natal Diagnostic Techniques (Regulation and Prevention of Misuse) Act, 1994 – Medical Negligence – Medico Legal Case – Dying Declaration-MCI act on medical education. The Biomedical Waste (Management and Handling) Rules-Radiation Safety System.		
Module – IV	**HOSPITAL OPERATIONS MANAGEMENT**	**9**
Front Office - Admission – Billing – Medical Records – Ambulatory Care- Death in Hospital – Brought-in Dead - Maintenance and Repairs Bio Medical Equipment Clinical Services - Clinical Departments – Out patient department (OPD) – Introduction – Location – Types of patients in OPD – Facilities – Flow pattern of patients – Training and Coordination; Radiology – Location – Layout – X-Ray rooms – Types of X-Ray machines – Staff - USG – CT – MRI – ECG. Supporting Services – House Keeping –Linen and Laundry, - Food Services - Central Sterile Supply Department (CSSD)		
Module – V	**PATIENT CARE MANAGEMENT**	**9**
Patient centric management-Concept of patient care, Patient-centric management, Organization of hospital departments, Roles of departments/managers in enhancing care, Patient counseling & Practical examples of patient centric management in hospitals-Patient safety and patient risk management. Quality in patient care management-Defining quality, Systems approach towards quality, Towards a quality framework, Key theories and concepts, Models for quality improvement & Variations in practice. Patient classification systems and the role of casemix-Why do we need to classify patients, Types of patient classification systems, ICD 9 (CM, PM), Casemix classification systems, DRG, HBG, ARDRG, Casemix innovations and Patient empowering classification systems.		
		Total: 45 Periods

Text Books

1. K.V.Ramani, “Hospital Management-Text and Cases”, Pearson, South Asia-India- First Edition, 2013

Reference Books

1. Mario de souza, “Hospital Management”, Jaypee Brothers Medical Publishers; First Edition, 2018
2. B.M.Sakharkar, “Principles of hospital administration and planning”, Jaypee Brothers Medical Publishers Pvt Limited,2nd edition,2009.
3. G.D.Kunders, “Hospitals–Facilities Planning and Management–TMH, New Delhi–Fifth Reprint 2007

4. Dinesh Bhatia, Prabhat Kumar Chaudhari, Bhupinder Chaudhary, Sushman Sharma, Kunaal Dhingra, "A Guide to Hospital Administration and Planning"-Springer (2023).
5. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI–Fourth Edition, 2006

Additional References

1. https://www.youtube.com/watch?v=ZZS8-ySBNFM, "Organization and Management of Hospital", Prof. S.B.Aroara, Professor, School of Health Sciences, Indira Gandhi National Open University(IGNOU), Maidan Garhi, New Delhi
2. http://www.nptelvideos.in/2012/11/human-resource-management-i.html,"Lecture Series on Human Resource Management-I", Prof. Kalyan Chakravarti, Vinod Gupta School of Management, IIT Kharagpur

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

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	10	
Apply			
	Attendance	0	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember				
Understand	30	30	30	60
Apply	20	20	20	40
Analyse				
Evaluate				
Create				

23BM404	BIOSENSORS AND MEASUREMENTS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core (PC)				
Pre requisites	Basics of Electrical Engineering and Biology				

Course Objectives

The course is intended to

1. Understand science of bio-measurement with desirable properties of biosensors, miniaturization and applications related to agriculture, bio-production and environment
2. Recognize in detail various electrochemical sensors and its sensing capabilities
3. Identify the principles behind Seismic (mass) and Thermal sensors for human body status
4. Appreciate biochemical assaying formats and molecular level recognition and optical sensors with its relevant source and detectors for non-invasive devices
5. Explore benefits of nanotechnology-based biosensors

Course Outcomes

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

CO.No	Course Outcome	Bloom's Level
CO 1	Realize common biochemical interactions used to quantify biological molecules and the electronic technologies used to detect and measure them	Understand
CO 2	Categorize principles of electrochemical sensors and its sensing capabilities	Apply
CO 3	To know the principles behind Seismic (mass) and Thermal sensors for humanbody status	Understand
CO 4	Comprehend biochemical assaying formats and molecular level recognition and optical sensors with its relevant source and detectors for non-invasive devices	Apply
CO 5	To copiously explore benefits of nanotechnology-based biosensors	Understand

Course Contents

Module – I SCIENCE OF BIOMEASUREMENT 9

Measurement System – Instrumentation – Classification and Characteristics of Transducers (Static and Dynamic) – Errors in Measurements – Calibration – Primary and secondary standards. Interfacing Biosensor to real world – resistive, capacitive, inductive types- LVDT Transducer – Catheter tip transducer. Major components of Biosensor based systems - Biosensor applications

Module – II ELECTROCHEMICAL SENSORS 9

Biochemical sensors - basic electrochemistry - Problems of specificity - Redox potentials, membrane potential - pH & conductivity, pO_2 and pCO_2 sensors, Biochemical recognition - Chemical reactions: history of gravimetric and colorimetric reactions; Potentiometric sensors (ISE's and ISFETs). Amperometry sensors; Charge sensing with FET

Module – III SEISMIC (MASS), GAS AND THERMAL SENSORS 9

Electromechanical resonance -Piezoelectric, Quartz crystal Microbalance (QCM), Hall effect Sensor, Proximity sensor and Gyroscopes - Henry's and ideal gas laws-Gas detection. Surface acoustic wave (SAW) devices; Atomic force microscopy (AFM); Thermometric detection

Module – IV ASSAYING FORMATS AND OPTICAL SENSORS 9

Immunoassays for plant and animal pathogen detection, Enzyme linked immune-sorbent assays (ELISA), bio-luminescent technologies for pathogen detection, molecularly imprinted polymers Fundamentals of optics, photodiodes, photomultiplier tubes, charge coupled devices, Surface plasmon resonance (SPR) based devices

Module – V NANOTECHNOLOGY BASED BIOSENSORS 9

Nanomaterials for Sensing Applications - Signal Amplification Using Nanomaterials for Biosensing – Nanomaterial Based Electro-Analytical Biosensors for Cancer and Bone porosity detection - Gold Nanostructure LSPR- based Biosensors for Biomedical Diagnosis - DNA Sensors- Employing Nanomaterials for Diagnostic Applications

Total: 45 Periods

Text Books

1. Eggins. B. R, "Chemical Sensors and Biosensors", John Wiley & Sons, 2014.
2. Jon Cooper, Tony Cass "Biosensors-A practical approach" 2nd edition Oxford University Press, (2014).
3. Tuantranont A., "Applications of Nanomaterials in Sensors and Diagnostics", Springer, 1st Edition, 2013

Reference Books

1. Florinel-Gabriel Banica "Chemical Sensors and Biosensors - Fundamentals and Applications" John Wiley & Sons, Ltd,2012
2. Gabor Harsanyi "Sensors in Biomedical Applications– Fundamentals, Technology & Applications" CRC Press,2014
3. Donald G. Buerk (Author) – Biosensors- Theory and Applications-CRC Press (2013)
4. Spichiger-Keller. U. E "Chemical Sensors and Biosensors for Medical and Biological Applications", Wiley-VCH, 2008.
5. Robert S. Marks, Christopher R. Lowe, David C. Cullen, Howard H. Weetall, Isao Karube "Handbook of Biosensors and Biochips" Vol 2-John Wiley & Sons (2017)

Additional References

1. **swayam - https://onlinecourses.swayam2.ac.in/nou23_bt05/unit?unit=1&lesson=4**

List of Experiments:

1. Temperature measurement using AD590 IC sensor
2. Displacement measurement by using a capacitive transducer
3. Study of the characteristics of a LDR, LED, PHOTO TRANSISTORS
4. Pressure and displacement measurement by using LVDT
5. Study & characterization of Bio-transducers – Pressure, Temperature, Humidity
6. Study & characterization of Bioelectrodes – ECG, EMG, EEG
7. Study & Characterization of Gas Sensor
8. Measurement of Blood Glucose Level

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

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Understand	Practical class	25	25
Apply			
	Attendance	0	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE) (25)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**(50)**
Remember				
Understand	40	20	30	30
Apply	10	30	20	20
Analyse				
Evaluate				
Create				

23BM405	Pathology and Microbiology	L	T	P	C
		3	0	2	3
Nature of Course	Professional core				
Pre requisites	Human Anatomy and Physiology				

Course Objectives

The course is intended to

1. To provide a comprehensive understanding of cell injury, adaptations, and ageing
2. To ensure a thorough understanding of homeostasis and haemodynamics, focusing on both the fundamental principles and the clinical implications of their derangements.
3. To comprehensive understanding of microbiology, from basic principles to clinical applications and research.
4. Learn the different staining methods and understanding the fundamental principles of microscopy and mastering practical skills
5. Comprehensive study of immunopathology, from basic immunological concepts to the clinical manifestations and management of immune-mediated diseases.

Course Outcomes

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

CO.No	Course Outcome	Bloom's Level
CO 1	Investigate structural and functional aspects of living organisms	Understand
CO 2	Summarize the diagnose, and manage conditions involving derangements in homeostasis and haemodynamic in clinical	Understand
CO 3	Interpret the the skills and knowledge necessary to work effectively in microbiology laboratories, clinical settings, and research environments.	Analyze
CO 4	Compare the methods involved in treating the pathological diseases	Apply
CO 5	Infer the immunology related concepts	Apply

Course Contents

Module – I CELL INJURY, CELLULAR ADAPTATIONS AND CELLULAR AGEING 9

Etiology of Cell Injury, Pathogenesis of Cell Injury, Morphology of Reversible Cell Injury, Intracellular Accumulations, Pigments, Morphology of Irreversible Cell Injury (Cell Death), Changes after Cell Death, Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Dysplasia. Cellular adaptation-wound healing and fight or flight response. Organ Changes in Ageing, Neoplasia, Classification of Tumors.

Module – II DERANGEMENTS OF HOMEOSTASIS AND HAEMODYNAMICS 9

Homeostasis- Normal Water and Electrolyte Balance, Acid-Base Balance, Pressure Gradients and Fluid Exchanges, Disturbances of Body Water- Oedema, Dehydration, Overhydration, Acid Base Imbalance, Edema, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders-Bleeding disorders, Leukemias, Lymphomas.

Module – III MICROBIOLOGY 9

Structure of Bacteria and Virus related to human body interactions. Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve. Identification of bacteria, culture media and its types, culture techniques and observation of culture. Disease caused by bacteria, fungi, protozoal, virus and Helminthes

Module – IV MICROSCOPIC STUDY OF PATHOGENS 9

Basics and techniques for microscopic study of pathogens using Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope. Staining methods – Simple, Gram staining and AFB staining.

Module – V IMMUNOPATHOLOGY 9

Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury: phagocytosis, inflammation, Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE. Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, Immuno electrophoresis, RIA and ELISA, monoclonal antibodies

Total: 45 Periods

LIST OF EXPERIMENTS Cycle-1

S.No.	Course Content	CO	Bloom's Level
1	Study of parts of compound microscope	CO1	Understand
2	Urine Examination: physical and chemical (protein, reducing substances, ketones, bilirubin and blood)	CO2	Apply
3	Histopathological slides of benign and malignant tumours.	CO2	Understand
4	Manual paraffin tissue processing and section cutting (demonstration)	CO3	Apply
5	Cryo processing of tissue and cryosectioning (demonstration)	CO3	Apply
6	Haematology slides of anaemia and leukaemia.	CO2	Understand
7	Study of bone marrow charts.	CO4	Remembering

Cycle-2

S.No.	Course Content	CO	Bloom's Level
8	Identify the type of bacteria by conducting Basic staining – Hematoxylin and eosin staining for the given Pathological tissue	CO 3	Understand
9	Identify the type of bacteria by conducting Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS for the given Pathological tissue	CO3	Understand
10	Perform capsule staining of given bacterial culture.	CO3	Apply
11	Identify the given sputum sample by performing AFB staining technique	CO3	Understand
12	Perform Gram staining of given bacterial culture.	CO3	Apply
13	Antigen-Antibody reaction Immunoelectrophoresis	CO5	Understand
14	Write a comment on slides of malarial parasites, micro filaria and leishmania donovani	CO4	Understand

Text Books

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, “Pathologic Basis of Diseases”, 7thedition,WB Saunders Co. 2005 (Unit I).

2. Harsh Mohan, "Text book of Pathology" 7th edition 2015, ISBN: 978-93-5152-369-7.(Unit-II)
3. Ananthanarayanan & Panicker, "Microbiology" Orient black swan, 2017 10th edition. (Units III, IV and V).
4. Textbook of Medical Laboratory Technology, Ramnik Sood, 6thEdition, Jaypee Brothers Medical Publishers, 2009.
5. Harsh Mohan, "Pathology Practical Book" 2nd Edition. Jaypee Brothers Medical Publishers (P) Ltd 2002.

Reference Books

1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
2. Dubey RC and Maheswari DK. "A Text Book of Microbiology" Chand & Company Ltd, 2007
3. Prescott, Harley and Klein, "Microbiology", 10th edition, McGraw Hill, 2017

Additional References

1. **Automotive Research Association of India - https://www.araiindia.com/services/technology-and-products**
2. **NPTEL - https://nptel.ac.in/courses/107/106/107106088/**
3. **MOOC Courses - https://www.mooc-list.com/tags/automotive-engineering**

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

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1		2			2			3						
CO 2	2				1				3			2		
CO 3					3	3		2	1					
CO 4		3				2		3		1	2	2		
CO 5														
	3-High				2-Medium				3- Low					

Formative Assessment

Blooms Taxonomy	Assessment Component	Marks	Total marks
Remember			25
Understand	Practical Exercises	25	
Analyze			
	Attendance	0	

Passed in Board of Studies Meeting CHAIRMAN - BOARD OF STUDIES *Approved in Academic Council Meeting*

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE) (25)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**(50)**
Remember				
Understand	20	20	20	40
Apply	20	20	20	40
Analyse	10	10	10	20
Evaluate				
Create				