MRK INSTITUTE OF TECHNOLOGY

AN AUTONOMOUS INSTITUTION

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

KATTUMANNARKOIL-608 301, CUDDALORE DISTRICT, TAMILNADU, INDIA

CHOICE BASED CREDIT SYSTEM

Programme: B.E. Biomedical Engineering **Regulations:** 2026

Abbreviations:

HUM – Humanities (Languages, Management, Heritage, and others)

BS – Basic Science (Mathematics, Physics, Chemistry)

ES – Engineering Science (General (**GE**), Programme Core (**PC**), Programme Elective (**PE**) & Emerging Technology (**ET**))

SD – Skill Development

SL – Self-Learning

CDP – Capstone Design Project

OE – Open Elective

L – Laboratory Course

T – Theory Course

LIT –Laboratory Integrated Theory

MC – Mandatory Course

PW – Project Work

IPW – Internship cum Project Work

DIC – Department Introductory Course

TCP –Total Contact Period(s)

Program Outcomes

1. **Engineering Knowledge**: Apply math, science and engineering fundamentals to complex problems.
2. **Problem Analysis**: Identify and analyze complex problems using research and sustainability principles
3. **Design Solutions**: Design systems and processes considering health, safety, cost, culture, and environment.
4. **Investigations**: Use experiments, modelling, and data analysis to reach valid conclusions.
5. **Engineering Tools**: Apply modern tools for modelling and problem-solving, recognizing their limits.
6. **Society & Environment**: Assess societal, legal, and environmental impacts of engineering solutions.
7. **Ethics**: Commit to ethics, human values, diversity, and legal compliance.
8. **Teamwork**: Work effectively as an individual and in multidisciplinary teams.
9. **Communication**: Communicate clearly in reports, presentations and documentation across diverse groups.
10. **Management & Finance**: Apply management and economic principles in projects and teamwork.
11. **Lifelong Learning**: Engage in continuous learning, adapt to new technologies, and think critically.

Program Specific Outcomes:

PSO1 To design, develop, and analyze biomedical devices and systems for real time applications.

PSO2 Utilize modern computational tools, instrumentation, and biomedical imaging techniques in the health sectors.

PSO3 To keep pace with advancements in biomedical technology and demonstrate Research aptitude, collaborate effectively in teams and uphold ethical practices.

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CHOICE BASED CREDIT SYSTEM

CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII

Semester – I							
S.No.	**Course Code**	**Course Title**	**Course Type**	**Periods / Week** L-T-P	**Total Contact Periods**	**Credits**	**Category**
3 Weeks Compulsory Induction Program							
1	26HSC01	தமிழர் மரபும் தொழில் நுட்பமும் / Tamils Heritage and Technology	T	1-0-0	1	1	HUM
2	26ENC01	English for Engineers	T	3-0-0	3	3	HUM
3	26MAC01	Applied Calculus and Matrices	T	3-1-0	4	4	BS
4	26PHC01	Engineering Physics	LIT	3-0-2	5	4	BS
5	26CYC01	Engineering Chemistry	LIT	3-0-2	5	4	BS
6	26EEC02	Basic Electronics and Electrical Engineering	T	3-0-0	3	3	ES(GE)
7	26CSC01	Programming Language: C	T	3-0-0	3	3	ES(PC)
8	26MEC02	Makerspace Laboratory	L	0-0-4	4	2	SD
9	26CSC02	Programming in C Laboratory	L	0-0-4	4	2	ES(PC)
10	26HSC02	Physical Education	-	-	-	-	HUM
				Total Credits	**32**	**26**	

Semester – II							
S.No.	**Course Code**	**Course Title**	**Course Type**	**Periods / Week** L-T-P	**Total Contact Periods**	**Credits**	**Category**
1	26MAC02	Linear Algebra	T	3-1-0	4	4	BS
2	26PHC03	Medical Physics	T	3-0-0	3	3	BS
3	26GEC01	Environmental Science and Sustainability	T	2-0-0	2	2	ES(GE)
4	26BM201	Biosciences for Medical Engineering	LIT	3-0-2	5	4	ES(PC)
5	26BM202	Anatomy and Physiology	LIT	3-0-2	5	4	ES(PC)
6	26CSC03	Problem Solving Using Python Programming	LIT	3-0-2	5	4	ES(PC)
7	26ENC02	Communicative English Laboratory	L	0-0-4	4	2	HUM
8		NCC/ NSS/ NSO/YRC#1	-	-	-	-	-
				Total Credits	**28**	**23**	

 # 1 NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

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Semester – III							
S.No.	Course Code	Course Title	Course Type	Periods / Week L-T-P	Total Contact Periods	Credits	Category
1	26MAC04	Probability and Random Processes	T	3-1-0	4	4	BS
2	26BM301	Electronic Devices and Circuits	T	3-0-0	3	3	ES(PC)
3	26BM302	Biomedical Signals and Systems	T	3-1-0	4	4	ES(PC)
4	26BM303	Electric Circuit Analysis	LIT	3-0-2	5	4	ES(PC)
5	26BMC01	Sensors and Measurement Systems	LIT	3-0-2	5	4	ES(PC)
6	26BM304	Healthcare Data Analytics	LIT	3-0-2	5	4	ES(PC)
7	26BM305	Devices and Circuits Laboratory	L	0-0-4	4	2	ES(PC)
8	26SDC01	Foundation Aptitude and Verbal ability skills	-	0-0-2	2	1	SD
9		Mandatory Course – I$	T	1-0-0	1	-	MC
				Total Credits	**33**	**26**	

$ Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

Semester – IV							
S.No.	Course Code	Course Title	Course Type	Periods / Week L-T-P	Total Contact Periods	Credits	Category
1	26BM401	Bio Control Systems	T	3-0-0	3	3	ES(PC)
2	26BM402	Instrumentation of Medical applications	T	3-0-0	3	3	ES(PC)
3	26BM403	Human Medical Ethics	T	3-0-0	3	3	ES(PC)
4	26BM404	Analog and Digital Integrated Circuits	T	3-0-0	3	3	ES(PC)
5	26BM405	Biomedical Digital Signal Processing	LIT	3-0-2	5	4	ES(PC)
6	26CSC16	Artificial Intelligence and Machine Learning	LIT	3-0-2	5	4	ES(PC)
7	26BM406	Analog and Digital Integrated Circuits Laboratory	L	0-0-4	4	2	ES (PC)
8	26SDC02	Professional, Verbal and Corporate Communication Skills	L	0-0-2	2	1	SD
9		Mandatory Course – II$	T	1-0-0	1	-	MC
10		NCC / NSS / NSO/ YRC #2	-	-	-	-	-
				Total Credits	**29**	**23**	

$ Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC- I)
#2 NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

Semester – V							
S.No.	**Course Code**	**Course Title**	**Course Type**	**Periods / Week L-T-P**	**Total Contact Periods**	**Credits**	**Category**
1	26BM501	Biomaterials	T	3-0-0	3	3	ES(PC)
2	26BM502	Radiological Equipment	T	3-0-0	3	3	ES(PC)
3	26BM503	Diagnostic and Therapeutic Equipment	T	3-0-0	3	3	ES (PC)
4		Programme Elective – I	T	3-0-0	3	3	ES(PE)
5		Programme Elective – II	T	3-0-0	3	3	ES(PE)
6	26BM504	Microcontrollers and Embedded Systems	LIT	3-0-2	5	4	ES (PC)
7	26IC501	Industry Oriented Course-I	LIT	1-0-2	3	1	SD
8		Mandatory Course – III $	T	1-0-0	1	-	MC
9	26IP501	Summer Internship*	-	-	-	1	IPW
10	26SDC03	Advanced Aptitude and Logical Reasoning Skills	-	0-0-2	2	1	SD
				Total Credits	**26**	**22**	

$ Mandatory Course-III is a Non-credit Course (Student shall select one course from the list given under MC)
***Two weeks Summer Internship carries one credit and it will be done during IV semester summer vacation and same will be evaluated in V semester.**

For Honours Degree							
S.No.	**Course Code**	**Course Title**	**Course Type**	**Periods / Week L-T-P**	**Total Contact Periods**	**Credits**	**Category**
		Capstone Design Project Level - I	CDP	0-0-12	12	6	SD
OR							
		Honours Elective – I	T	3-0-0	3	3	
		Honours Elective – II	T	3-0-0	3	3	
For Minor Degree							
		Minor Elective – I	T	3-0-0	3	3	
		Minor Elective – II	T	3-0-0	3	3	

Semester – VI							
S.No.	**Course Code**	**Course Title**	**Course Type**	**Periods / Week** L-T-P	**Total Contact Periods**	**Credits**	**Category**
1	26BM601	Advanced Diagnostic and Treatment Equipment	T	3-0-0	3	3	ES(PC)
2	26BM602	Biomechanics	T	3-0-0	3	3	ES(PC)
3		Programme Elective – III	T	3-0-0	3	3	ES(PE)
4		Open Elective	T	3-0-0	3	3	ES(ET)
5	26IC601	Industry Oriented Course – II	LIT	1-0-2	3	1	SD
6	26BM603	Biomedical System Modeling Laboratory	L	0-0-4	4	2	ES(PC)
7	26BM604	Diagnostic and Treatment Equipment Laboratory	L	0-0-4	4	2	ES(PC)
8	26SDC04	Technical Interview and Advanced Competitive Examination Skills	-	0-0-2	2	1	SD
9		Mandatory Course – IV$	T	1-0-0	1	-	MC
10		Self Learning Course	-	-	-	1	SL
11		NCC / NSS / NSO/ YRC #3	-	-	-	-	-
				Total Credits	**26**	**19**	

$ Mandatory Course-IV is a Non-credit Course (Student shall select one course from the list given under MC-IV).
#3 NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

For Honours Degree							
S.No.	**Course Code**	**Course Title**	**Course Type**	**Periods / Week** L-T-P	**Total Contact Periods**	**Credits**	**Category**
1		Capstone Design Project Level - II	CDP	0-0-12	12	6	SD
OR							
1		Honours Elective – III	T	3-0-0	3	3	
2		Honours Elective – IV	T	3-0-0	3	3	
For Minor Degree							
1		Minor Elective – III	T	3-0-0	3	3	
2		Minor Elective – IV	T	3-0-0	3	3	

Semester – VII							
S.No.	Course Code	Course Title	Course Type	Periods / Week L-T-P	Total Contact Periods	Credits	Category
1	26BM701	Hospital Management	T	3-0-0	3	3	ES(PC)
2		Programme Elective – IV	T	3-0-0	3	3	ES(PE)
3		Programme Elective – V	T	3-0-0	3	3	ES(PE)
4	26HSC04	Professional Ethics and Human Values	T	2-0-0	2	2	HUM
5	26BM702	Innovation and Entrepreneurship in Healthcare	LIT	2-0-2	4	3	ES(PE)
6	26BM703	Medical Image Processing	LIT	3-0-2	5	4	ES(PC)
7	26SDC05	Professional Employability and Technical Communication Skills	-	0-0-2	2	1	SD
8		Mandatory Course – V$	T	1-0-0	1	-	MC
9		Hospital Training*	-	-	-	2	SD
10	26IP701	Summer Internship*	-	-	-	1	IPW
				Total Credits	**23**	**22**	

$ Mandatory course-V is a Non-credit course (Student shall select one course from the list given under MC-V).
***Two weeks Summer Internship carries one credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.**

For Honours Degree							
S.No.	Course Code	Course Title	Course Type	Periods / Week L-T-P	Total Contact Periods	Credits	Category
1		Capstone Design Project Level - III	CDP	0-0-12	12	6	SD
OR							
1		Honours Elective – V	T	3-0-0	3	3	
2		Honours Elective – VI	T	3-0-0	3	3	
For Minor Degree							
1		Minor Elective – V	T	3-0-0	3	3	
2		Minor Elective – VI	T	3-0-0	3	3	

Semester – VIII							
S.No.	Course Code	Course Title	Course Type	Periods / Week L-T-P	Total Contact Periods	Credits	Category
1	26BM801	Project Work / Internship cum Project Work	PW / IPW	0-0-16	16	8	SD
				Total Credits	**16**	**8**	

PROGRAMME ELECTIVE COURSES: STREAMS

Bio Engineering	Digital Health	Medical Device Development	Assistive Technology	Management Healthcare
Biomedical Instrumentation	Medical Informatics	Foundation Skills in Integrated Product Development	Extended Reality in Healthcare	Clinical Engineering
Artificial Organs and Implants	Telehealth Technology	Medical Device Design	Rehabilitation Engineering	Hospital Planning and Management
Neural Engineering	Brain Computer Interface and Applications	Advancements in Healthcare Technology	Physiological Modelling	Medical Waste Management
Principles of Tissue Engineering	Biometrics	Rapid Prototyping	Assistive Technology and devices	Economics and Management for Engineers
Health informatics	Soft Computing and its applications	Internet of Medical Things	Robotics in Medicine	Forensic Science in Healthcare
BIOMEMS	Deep Learning	Implantable and Surgical Device Design	Sports Engineering and Technology	Bio and E Waste Management
Biomedical Optics and Photonics	Healthcare Analytics & Big Data	Rehabilitation and Assistive Medical Devices	Prosthetics and Orthotics	Healthcare Quality Management and Accreditation
Biosensors & Bioelectronics	Medical Image Processing	In-Vitro Diagnostics and Point-of-Care Devices	Haptics, Human-Machine Interface and Virtual Rehabilitation	Healthcare Operations and Process Management
Additive Manufacturing & 3D Bioprinting	IoMT & Wearable Healthcare	Clinical Translation, Entrepreneurship and Medical Device Innovation	Augmentative and Alternative Communication Technologies	Healthcare Risk Management and Patient Safety
Medical Device Design & Regulation	Health Data Standards, Security and Ethics	Medical Device Testing, Validation and Verification	Wheelchairs and Mobility Assistive Devices	Healthcare Entrepreneurship and Innovation

PROGRAMME ELECTIVE COURSES: VERTICALS

VERTICAL 1:BIO ENGINEERING							
Sl.No	**Course Code**	**Course Title**	**Course Type**	**Periods / Week** L-T-P	**Total Contact Periods**	**Credits**	**Category**
1	26BM001	Biomedical Instrumentation	T	3-0-0	3	3	ES(PE)
2	26BM002	Artificial Organs and Implants	T	3-0-0	3	3	ES(PE)
3	26BM003	Neural Engineering	T	3-0-0	3	3	ES(PE)
4	26BM004	Principles of Tissue Engineering	T	3-0-0	3	3	ES(PE)
5	26BM005	Health informatics	T	3-0-0	3	3	ES(PE)
6	26BM006	BIOMEMS	T	3-0-0	3	3	ES(PE)
7	26BM007	Biomedical Optics and Photonics	T	3-0-0	3	3	ES(PE)
8	26BM008	Biosensors & Bioelectronics	T	3-0-0	3	3	ES(PE)
9	26BM009	Additive Manufacturing & 3D Bioprinting	T	3-0-0	3	3	ES(PE)
10	26BM010	Medical Device Design & Regulation	T	3-0-0	3	3	ES(PE)

VERTICAL 2: DIGITAL HEALTH							
Sl.No	**Course Code**	**Course Title**	**Course Type**	**Periods / Week** L-T-P	**Total Contact Periods**	**Credits**	**Category**
1	26BM011	Medical Informatics	T	3-0-0	3	3	ES(PE)
2	26BM012	Telehealth Technology	T	3-0-0	3	3	ES(PE)
3	26BM013	Brain Computer Interface and Applications	T	3-0-0	3	3	ES(PE)
4	26BM014	Biometrics	T	3-0-0	3	3	ES(PE)
5	26BM015	Soft Computing and its applications	T	3-0-0	3	3	ES(PE)
6	26BM016	Deep Learning	T	3-0-0	3	3	ES(PE)
7	26BM017	Healthcare Analytics & Big Data	T	3-0-0	3	3	ES(PE)
8	26BM018	Medical Image Processing	T	3-0-0	3	3	ES(PE)
9	26BM019	IoMT & Wearable Healthcare	T	3-0-0	3	3	ES(PE)
10	26BM020	Health Data Standards, Security and Ethics	T	3-0-0	3	3	ES(PE)

VERTICAL 3: MEDICAL DEVICE DEVELOPMENT							
Sl.No	**Course Code**	**Course Title**	**Course Type**	**Periods / Week** L-T-P	**Total Contact Periods**	**Credits**	**Category**
1	26BM021	Foundation Skills in Integrated Product Development	T	3-0-0	3	3	ES(PE)
2	26BM022	Medical Device Design	T	3-0-0	3	3	ES(PE)
3	26BM023	Advancements in Healthcare Technology	T	3-0-0	3	3	ES(PE)
4	26BM024	Rapid Prototyping	T	3-0-0	3	3	ES(PE)

5	26BM025	Internet of Medical Things	T	3-0-0	3	3	ES(PE)
6	26BM026	Implantable and Surgical Device Design	T	3-0-0	3	3	ES(PE)
7	26BME27	Rehabilitation and Assistive Medical Devices	T	3-0-0	3	3	ES(PE)
8	26BME28	In-Vitro Diagnostics and Point-of-Care Devices	T	3-0-0	3	3	ES(PE)
9	26BME29	Clinical Translation, Entrepreneurship and Medical Device Innovation	T	3-0-0	3	3	ES(PE)
10	26BME30	Medical Device Testing, Validation and Verification	T	3-0-0	3	3	ES(PE)

VERTICAL 4:ASSISTIVE TECHNOLOGY							
Sl.No	**Course Code**	**Course Title**	**Course Type**	**Periods / Week** L-T-P	**Total Contact Periods**	**Credits**	**Category**
1	26BM031	Extended Reality in Healthcare	T	3-0-0	3	3	ES(PE)
2	26BM032	Rehabilitation Engineering	T	3-0-0	3	3	ES(PE)
3	26BM033	Physiological Modelling	T	3-0-0	3	3	ES(PE)
4	26BM034	Assistive Technology and devices	T	3-0-0	3	3	ES(PE)
5	26BM035	Robotics in Medicine	T	3-0-0	3	3	ES(PE)
6	26BM036	Sports Engineering and Technology	T	3-0-0	3	3	ES(PE)
7	26BM037	Prosthetics and Orthotics	T	3-0-0	3	3	ES(PE)
8	26BM038	Haptics, Human-Machine Interface and Virtual Rehabilitation	T	3-0-0	3	3	ES(PE)
9	26BM039	Augmentative and Alternative Communication Technologies	T	3-0-0	3	3	ES(PE)
10	26BM040	Wheelchairs and Mobility Assistive Devices	T	3-0-0	3	3	ES(PE)

VERTICAL 5: MANAGEMENT HEALTHCARE							
Sl.No	**Course Code**	**Course Title**	**Course Type**	**Periods / Week** L-T-P	**Total Contact Periods**	**Credits**	**Category**
1	26BME041	Clinical Engineering	T	3-0-0	3	3	ES(PE)
2	26BME042	Hospital Planning and Management	T	3-0-0	3	3	ES(PE)
3	26BME043	Medical Waste Management	T	3-0-0	3	3	ES(PE)
4	26BME044	Economics and Management for Engineers	T	3-0-0	3	3	ES(PE)
5	26BME045	Forensic Science in Healthcare	T	3-0-0	3	3	ES(PE)
6	26BME046	Bio and E Waste Management	T	3-0-0	3	3	ES(PE)
7	26BME047	Healthcare Quality Management and Accreditation	T	3-0-0	3	3	ES(PE)
8	26BME048	Healthcare Operations and Process Management	T	3-0-0	3	3	ES(PE)
9	26BME049	Healthcare Risk Management and Patient Safety	T	3-0-0	3	3	ES(PE)
10	26BME050	Healthcare Entrepreneurship and Innovation	T	3-0-0	3	3	ES(PE)

OPEN ELECTIVES (EMERGING TECHNOLOGIES)							
Sl.No	**Course Code**	**Course Title**	**Course Type**	**Periods / Week L-T-P**	**Total Contact Periods**	**Credits**	**Category**
1	26OE901	AI-Driven Decision Support Systems	T	3-0-0	3	3	OE
2	26OE902	Emerging Technologies for Digital Transformation	T	3-0-0	3	3	OE
3	26OE903	Future Technologies for Intelligent Industries	T	3-0-0	3	3	OE
4	26OE904	Climate Change and Infrastructure Resilience	T	3-0-0	3	3	OE
5	26OE905	Environmental Sustainability and Resource Management	T	3-0-0	3	3	OE
6	26OE906	Green Building Technologies	T	3-0-0	3	3	OE
7	26OE907	Battery Technologies and Management Systems	T	3-0-0	3	3	OE
8	26OE908	Energy Management and Conservation	T	3-0-0	3	3	OE
9	26OE909	Renewable Energy Technologies	T	3-0-0	3	3	OE
10	26OE910	Smart Grid Technologies	T	3-0-0	3	3	OE
11	26OE911	IoT-Enabled Healthcare Technologies	T	3-0-0	3	3	OE
12	26OE912	Wearable Health Technologies	T	3-0-0	3	3	OE
13	26OE913	Biomedical Signal & Image Processing	T	3-0-0	3	3	OE
14	26OE914	Mobile Communication	T	3-0-0	3	3	OE
15	26OE915	Systems on Chip with IoT applications	T	3-0-0	3	3	OE
16	26OE916	Opto Nano Electronics	T	3-0-0	3	3	OE
17	26OE917	Mechatronics and Smart Systems	T	3-0-0	3	3	OE
18	26OE918	Finite Element Analysis for Engineers	T	3-0-0	3	3	OE
19	26OE919	Energy Audit and Energy Management	T	3-0-0	3	3	OE
20	26OE920	Industrial Safety	T	3-0-0	3	3	OE

Mandatory courses							
Sl.No	**Course Code**	**Course Title**	**Course Type**	**Periods / Week L-T-P**	**Total Contact Periods**	**Credits**	**Category**
1	26MCC01	Disaster Management and Safety Awareness	T	3-0-0	3	-	MC
2	26MCC02	Gender Sensitization and Inclusive Society	T	3-0-0	3	-	MC
3	26MCC03	Constitution of India	T	3-0-0	3	-	MC
4	26MCC04	Digital Literacy and Cyber Awareness	T	3-0-0	3	-	MC
5	26MCC05	Research Methodology and Intellectual Property Rights	T	3-0-0	3	-	MC

Semester wise Credit Distribution

Course Category	Code	I	II	III	IV	V	VI	VII	VIII	Total Credits	% Share
Basic Science	BS	12	7	4	-	-	-	-	-	**23**	**13.6**
Humanities	HUM	4	2	-	-	-	-	2	-	**8**	**4.7**
Engineering Science (General)	ES(GE)	3	2	-	-	-	-	-	-	**5**	**2.9**
Programme Core	PC	5	12	21	22	13	10	7	-	**90**	**53.5**
Programme Elective	PE	-	-	-	-	6	3	9	-	**18**	**10.7**
Open Elective(ET)	OE	-	-	-	-	-	3	-	-	**3**	**1.7**
Skill Development	SD	2	-	1	1	2	2	3	8	**19**	**11.3**
Internship cum Project Work	IPW	-	-	-	-	1	-	1	-	**2**	**1.1**
Self-Learning	SL	-	-	-	-	-	-	-	-	**0**	**0**
Total Credits	-	**26**	**23**	**26**	**23**	**22**	**18**	**22**	**8**	**168**	**100**

SEMESTER – I

26HSC01	தமிழர் மரபும் தொழில் நுட்பமும் / Tamils Heritage and Technologies	L	T	P	C
		1	0	0	1

Course Objectives:

- தமிழ்மொழி, திராவிட மொழிகள், சங்க இலக்கியம் மற்றும் தமிழர்களின் பண்பாட்டு மரபுகளை அறிந்து விளக்குதல்.
- தமிழர்களின் நாட்டுப்புறக் கலைகள், விளையாட்டுகள், தெய்வ வழிபாடு மற்றும் கைவினை மரபுகளை அறிந்து அவற்றின் முக்கியத்துவத்தை விளக்குதல்.
- தமிழர்களின் பாரம்பரிய கட்டிடக்கலை, சிற்பக்கலை மற்றும் கட்டுமானத் தொழில்நுட்பங்களை அறிந்து அவற்றின் சிறப்புகளை விளக்குதல்.
- பண்டைய தமிழர்களின் கப்பல் கட்டுதல், உலோகத் தொழில்நுட்பம், மணிகள் தயாரித்தல் மற்றும் வாணிபத் தொழில்நுட்பங்களை அறிந்து விளக்குதல்.
- தமிழர்களின் வேளாண்மை, நீர்ப்பாசன முறைகள், கால்நடைப் பராமரிப்பு மற்றும் கடல்சார் அறிவியல் தொழில்நுட்பங்களை அறிந்து அவற்றின் முக்கியத்துவத்தை விளக்குதல்.

அலகு I	மொழி மற்றும் இலக்கிய மரபுகள்	3

இந்திய மொழிக் குடும்பங்கள், திராவிட மொழி வகைகள், முச்சங்க வரலாறு, சங்க இலக்கியத்தில் அறச்சிந்தனைகள், சங்க இலக்கியமும் பண்பாட்டு மரபுகளும், தமிழ் ஒரு செம்மொழி, திருக்குறளில் மேலாண்மைக் கருத்துகள், சங்ககாலத்தில் கல்வி, சங்ககால நகரங்களும் துறைமுகங்களும், பெரியபுராணம், நாயன்மார்கள் மற்றும் ஆழ்வார்களின் பக்திநெறி

அலகு II	நாட்டுப்புறக் கலைகளின் மரபுகள்	3

நாட்டுப்புறக் கலையின் தோற்றம் மற்றும் வளர்ச்சி, தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், புலியாட்டம், தமிழர்களின் விளையாட்டுகள், நாட்டுப்புறத் தெய்வங்களின் வகைகள், சிற்பக்கலை, நடுகல் வழிபாடு, கைவினைப் பொருட்கள், இசைக்கருவிகளின் வகைகள்.

அலகு III	தமிழர்களின் கட்டிடத் தொழில்நுட்பம்	3

சங்க காலத்தில் நெசவு மற்றும் பானைத் தொழில்நுட்பம், சங்ககாலத்தில் கட்டுமானங்கள், வீட்டு பொருட்களின் வடிவமைப்பு, சங்ககாலத்தில் கட்டுமான பொருட்கள், சிலப்பதிகாரத்தில் மேடை அமைப்பு, மாமல்லபுரம் சிற்பங்களும் கோவில்களும் சோழர் கால பெருங்கோயில்கள், வழிபாட்டுத்தலங்கள்,மீனாட்சி அம்மன் ஆலயம்,செட்டிநாட்டு கட்டிடக் கலை, திருமலை நாயக்கர் மஹால்.

அலகு IV	உற்பத்தித் தொழில்நுட்பம்	3

கப்பல் கட்டும் கலை, இரும்பு தொழிற்சாலை, செம்பு மற்றும் தங்க நாணயங்கள் அச்சடித்தல், கண்ணாடி மணிகள், சுடுமண் மணிகள், சங்கு மணிகள் , கல்மணிகள் சிலப்பதிகாரத்தில் மணிகளின் வகைகள், ,தொல்லியல் சான்றுகள்,சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி.

அலகு V	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்	3

அணை ஏரி குளங்கள் மதகு அமைப்பு சோழர் கால குமுழி தூம்பின் முக்கியத்துவம், கால்நடை பராமரிப்பு, வேளாண்மை சார்ந்த செயல்பாடுகள், பெருங்கடல் குறித்த பண்டைய அறிவு , முத்துக்குளித்தல், அறிவுசார் சமூகம், கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி. அறிவியல் தமிழின் வளர்ச்சி, கணித்தமிழ் வளர்ச்சி.

TOTAL : 15 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. மா. இராசமாணிக்கனார், தமிழர் நாகரிகமும் பண்பாடும், சைவசித்தாந்த நூற்பதிப்புக் கழகம், சென்னை.
2. கே. கே. பிள்ளை, தமிழக வரலாறு – மக்களும் பண்பாடும், உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை.

References:

1. ந. சுப்பிரமணியன், தமிழக வரலாறு, தமிழ்நாட்டுப் பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், சென்னை.
2. இரா. நாகசாமி, தமிழகத் தொல்லியல், தமிழ்நாடு அரசு தொல்லியல் துறை, சென்னை.
3. குடவாயில் பாலசுப்ரமணியன், தமிழர் கட்டிடக்கலை, தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்.
4. கா. சிவத்தம்பி, தமிழின் சமூக வரலாறு, நியூ செஞ்சுரி புக் ஹவுஸ், சென்னை.
5. தமிழ்ப் பல்கலைக்கழகம், தமிழர் தொழில்நுட்பம், தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்.

E-resources:

1. https://www.tamilvu.org/
2. https://www.projectmadurai.org/
3. https://www.tnarch.gov.in/

CO	CO Description	PO	PSO
CO1	தமிழ்மொழி, திராவிட மொழிகள், சங்க இலக்கியம் மற்றும் தமிழர்களின் பண்பாட்டு மரபுகளை அறிந்து விளக்குதல்.	PO1(2) PO2(2)	PSO3(2)
CO2	தமிழர்களின் நாட்டுப்புறக் கலைகள், விளையாட்டுகள், தெய்வ வழிபாடு மற்றும் கைவினை மரபுகளை அறிந்து அவற்றின் முக்கியத்துவத்தை விளக்குதல்.	PO1 (2) PO7 (3) PO8 (3)	PSO1(1) PSO3 (2)
CO3	தமிழர்களின் பாரம்பரிய கட்டிடக்கலை, சிற்பக்கலை மற்றும் கட்டுமானத் தொழில்நுட்பங்களை அறிந்து அவற்றின் சிறப்புகளை விளக்குதல்.	PO1 (3) PO2 (3)	PSO2 (2) PSO3 (2)
CO4	பண்டைய தமிழர்களின் கப்பல் கட்டுதல், உலோகத் தொழில்நுட்பம், மணிகள் தயாரித்தல் மற்றும் வாணிபத் தொழில்நுட்பங்களை அறிந்து விளக்குதல்.	PO1 (2) PO2 (2) PO3 (2) PO7 (3)	PSO2 (2) PSO3 (2)
CO5	தமிழர்களின் வேளாண்மை, நீர்ப்பாசன முறைகள், கால்நடைப் பராமரிப்பு மற்றும் கடல்சார் அறிவியல் தொழில்நுட்பங்களை அறிந்து அவற்றின் முக்கியத்துவத்தை விளக்குதல்.	PO2 (3) PO5 (3) PO6 (3)	PSO1 (2) PSO2 (2) PSO3 (3)

(1) = Low; (2) = Medium; (3) = High

26HSC01	Tamils Heritage and Technologies	L	T	P	C
		1	0	0	1

Course Objectives:

- Identify and explain the Tamil language, Dravidian languages, Sangam literature, and cultural heritage of the Tamils.
- Identify and explain the importance of folk arts, traditional games, folk deities, and handicraft traditions of the Tamils.
- Study and explain the significance of traditional architecture, sculpture, and construction technologies of the Tamils.
- Explain the shipbuilding, metallurgical, bead-making, and trade technologies practiced by the ancient Tamils.
- Explain the importance of agriculture, irrigation systems, animal husbandry, and maritime knowledge and technologies of the Tamils.

Unit I	Language and Literary Heritage	3

Indian language families, varieties of Dravidian languages, history of Muthamizh, ethical thoughts in Sangam literature, Sangam literature and cultural traditions, Tamil as a classical language, management concepts in Thirukkural, education during the Sangam period, Sangam-age cities and ports, Periyapuranam, and the devotional traditions of Nayanmars and Alvars.

Unit II	Traditions of Folk Arts	3

Origin and development of folk arts, Therukoothu, Karagattam, Villupattu, Kaniyan Koothu,Oyilattam, Tholpavai Koothu, Silambattam, Puliyattam, traditional games of the Tamils, types of folk deities, sculpture, hero-stone worship, handicrafts, and types of musical instruments.

Unit III	Architectural Technology of the Tamils	3

Weaving and pottery technology during the Sangam period, construction practices during the Sangam period, design of household articles, construction materials used during the Sangam period, stage arrangement described in Silappathikaram, sculptures and temples of Mamallapuram, great temples of the Chola period, places of worship, Meenakshi Amman Temple, Chettinad architecture, and Thirumalai Nayak Palace.

Unit IV	Manufacturing Technology	3

Shipbuilding technology, iron industry, production and minting of copper and gold coins, glass beads, terracotta beads, conch-shell beads, stone beads, varieties of beads mentioned in Silappathikaram, archaeological evidences, and export and import during the Sangam period.

Unit V	Agriculture and Irrigation Technology	3

Dams, lakes and ponds, sluice structures, significance of the *Kumizhi Thoompu* during the Chola period, animal husbandry, agriculture-related activities, ancient knowledge of the ocean, pearl diving, knowledge-based society, achievements of the Cholas in overseas countries, development of scientific Tamil, and development of computational Tamil.

TOTAL : 15 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. K. K. Pillay, A Social History of the Tamils, University of Madras, Chennai.
2. R. Nagaswamy, Tamil Nadu: An Archaeological Perspective, Tamil Nadu State Department of Archaeology, Chennai.

References:

1. K. A. Nilakanta Sastri, A History of South India, From Prehistoric Times to the Fall of Vijayanagar, Oxford University Press, 4th Edition, New Delhi, 2015.
2. N. Subrahmanian, Social and Cultural History of Tamilnadu, Koodal Publishers, Madurai.
3. S. R. Balasubrahmanyam, Early Chola Art, Asia Publishing House, Bombay.
4. C. Sivaramamurti, South Indian Bronzes, Lalit Kala Akademi, New Delhi.

5. Noboru Karashima, A Concise History of South India: Issues and Interpretations, Oxford University Press, New Delhi. 1st Edition, 2014.
E-resources:
1. https://www.tamilvu.org/ 2. https://www.projectmadurai.org/ 3. https://www.tnarch.gov.in/

CO	CO Description	PO	PSO
CO1	Identify and explain the Tamil language, Dravidian languages, Sangam literature, and cultural heritage of the Tamils.	PO1 (2) PO2 (2)	PSO3 (2)
CO2	Identify and explain the importance of folk arts, traditional games, folk deities, and handicraft traditions of the Tamils.	PO1 (2) PO7 (3) PO8 (3)	PSO1 (1) PSO3 (2)
CO3	Study and explain the significance of traditional architecture, sculpture, and construction technologies of the Tamils.	PO1 (3) PO2 (3)	PSO2 (2) PSO3 (2)
CO4	Explain the shipbuilding, metallurgical, bead-making, and trade technologies practiced by the ancient Tamils.	PO1 (2) PO2 (2) PO3 (2) PO7 (3)	PSO2 (2) PSO3 (2)
CO5	Explain the importance of agriculture, irrigation systems, animal husbandry, and maritime knowledge and technologies of the Tamils.	PO2 (3) PO5 (3) PO6 (3)	PSO1 (2) PSO2 (2) PSO3 (3)

(1) = Low; (2) = Medium; (3) = High

26ENC01	English for Engineers	L	T	P	C
		3	0	0	3

Course Objectives:

- Develop vocabulary and grammatical competence by strengthening students' knowledge and appropriate usage in different contexts.
- Facilitate reading and comprehension skills through the effective use in academic and professional texts.
- Improve oral communication and presentation skills to strengthen content and context
- Enhance effective listening skills by familiarizing students with different accents, dialects, varieties of English
- Enable students to write professional correspondence and ethical writing practices.

Unit I	Vocabulary and Grammar	9

Academic Word List (AWL) - Foreign Words - Semantics - synonyms, antonyms, one-word substitution - Phrasal verbs - Phrases and idioms - Misspelt words; Parts of Speech - Subject-verb agreement - Tenses - Articles - Voices - Reported speech – Modals- Sentence structure

Suggested Activities: Gap fills exercises, Cloze Test, Error Detection and Spell Bee.

Unit II	Reading and Comprehension	9

Four types of Reading Techniques - Scanning, Skimming, Intensive reading, Extensive reading - Fiction and Non-fiction texts - Difference, features, strategies, comprehension - Strategies for reading general and professional content - Identifying transitions in a text - Note making - Interpreting charts and data; Academic reading - PQRST, SQ3R - Critical reading - Effective use of resources - Index, table of contents and glossary

Suggested Activities: Reading - newspaper and digital articles, Reading comprehension, note making and summarizing.

Unit III	Speaking	9

Importance of oral communication - Phonetics - Pronunciation, Stress and Intonation; Speaking in different contexts - verbal and non-verbal behavior; Presentation Skills - Types of Presentations - informative, persuasive, business - effective slide presentation - delivering a presentation; Classroom participation – Group Discussions, Debates, Group activities

Suggested Activities: Just a Minute (JAM) Video recording, Situational role plays, Usage of Apps.

Unit IV	Listening	9

Listening - Types - Purpose - Barriers - Strategies for effective listening in various contexts - Note-taking as a tool for effective listening - Dialects, accents, and slang - Dialectical Varieties - English in India,

Suggested Activities: Listening and Repeating, Note-taking

Unit V	Writing	9

Importance of written communication - Letter writing and e-mail - Reporting/Reports - Introduction to abstracts and articles - Difference between abstract and executive summary; Summarizing - Paraphrasing - Synthesizing - Editing and Proofreading - Plagiarism - Referencing online and offline resources.

Suggested Activities: Picture and poster description, Brainstorming and Mind Mapping.

TOTAL : 45 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principles and Practice, 4th Edition, Oxford University Press, New Delhi, 2022.
2. M. Ashraf Rizvi, Effective Technical Communication, 2nd Edition, McGraw Hill Education, New Delhi, 2018.

References:
1.Department of Humanities and Social Sciences, Anna University, English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Blackswan, Chennai, 2006. 2. Nitin Bhatnagar and Mamta Bhatnagar, Communicative English for Engineers and Professionals, 3. Pearson Education, 2010. Board of Editors, Vibrant English, Orient Blackswan, Chennai, 2013. 4. William Strunk Jr. & E.B. White, The Elements of Style, 4th Edition, Pearson, 1999. 5. David F. Beer and David McMurrey, Guide to Writing as an Engineer, 5th Edition, John Wiley, New York, 2021.
E-resources:
1. https://learnenglish.britishcouncil.org/ 2. https://www.bbc.co.uk/learningenglish 3. https://learnenglish.britishcouncil.org/skills/speaking

CO	CO Description	PO	PSO
CO1	Apply appropriate vocabulary and grammatical structures accurately and effectively in academic, professional, and everyday communication.	PO7(2) PO9(3)	PSO2(1) PSO3(2)
CO2	Employ suitable reading strategies **to** comprehend, analyze, interpret, and critically evaluate general, academic, and professional texts.	PO2(3) PO9(3)	PSO2(1) PSO3(2)
CO3	Demonstrate effective speaking and presentation skills with appropriate pronunciation, stress intonation in individual and group settings.	PO8(3)	PSO1 (1) PSO2(1) PSO3(3)
CO4	Demonstrate effective listening skills by identifying key information, understanding different accents and varieties of English.	PO2(2) PO6(1)	PSO2(1) PSO3(2)
CO5	Produce clear, coherent, and professionally appropriate written documents**.**	PO10(2) PO11(3)	PSO1(1) PSO2(1) PSO3(2)

(1) = Low; (2) = Medium; (3) = High

26MAC01	Applied Calculus and Matrices	L	T	P	C
		3	1	0	4

Course Objectives:

- To provide technical competence of modelling engineering problems using calculus.
- To apply the calculus concepts in solving engineering problems using analytical methods and computational tools.

Unit I	Differential Calculus	12

Functions, graph of functions, Limit of a function, Continuity, Limits at infinity, Derivative as a function, Maxima and Minima of functions of single variable, Mean value theorem.

Suggested Activities: Visualization of the functions, Maxima and Minima of a function using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Unit II	Functions of Several Variables	12

Partial derivatives, Total derivative, Taylor's series formula for functions of two variables, Maxima and minima of functions of two variables, Method of Lagrange's Multipliers.

Suggested Activities: Partial Derivatives with two or three variables, Maxima and Minima of a function using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Unit III	Integral Calculus	12

Fundamental theorem of Calculus, Indefinite integrals and Improper integrals, Evaluation of double integrals, Change of order of integration, Evaluation of triple integrals.

Suggested Activities: Definite and Indefinite Integrals, Determination of double and triple integrals, Solving of Competitive Examination questions (Ex. GATE).

Unit IV	Matrices	12

Eigen values and Eigen vectors of a real matrix, Characteristic equation, Properties of Eigen values and Eigen vectors (without proof) Cayley–Hamilton Theorem, Applications of Cayley–Hamilton Theorem.

Suggested Activities: Compute Eigen values and Eigen vectors, verify the Cayley–Hamilton theorem, and perform matrix computations using open-source software.

Unit V	Orthogonal Transformations and Quadratic Forms	12

Diagonalization of matrices by orthogonal transformation – Quadratic forms – Reduction of a quadratic form to canonical form by orthogonal transformation, Nature of quadratic forms.

Suggested Activities: Perform orthogonal diagonalization, reduce quadratic forms to canonical form, determine the nature of quadratic forms, and visualize quadratic forms using open-source software.

TOTAL : 60 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. Grewal, B. S. (2025). Higher Engineering Mathematics, 45th Edition, Khanna Publishers, New Delhi. .
2. Ramana, B. V. (2024). Higher Engineering Mathematics, 18th Edition, McGraw Hill Education (India) Private Limited.

References:

1. Anton, H., Bivens, I. C., & Davis, S. (2021). Calculus: Early transcendentals, John Wiley & Sons.
2. Waner, S., & Costenoble, S. (2024). Applied Calculus, 8th Edition, Cengage Learning.
3. Stroud, K. A., & Booth, D. J. (2020). Engineering Mathematics, 8th Edition, Red Globe Press.
4. Thomas, G. B., Jr., Weir, M. D., Hass, J., & Heil, C. (2022). Thomas' Calculus: Early Transcendentals, 15th Edition, Pearson.
5. Anton, H., Rorres, C., & Kaul, A. (2021). Elementary Linear Algebra: Applications Version, 12th Edition, John Wiley & Sons.

E-resources:

1. https://onlinecourses.nptel.ac.in/noc17_hs04
2. https://math.libretexts.org/Bookshelves/Calculus/Map%3A_Calculus__Early_Trans cendentals_(Stewart)/
3. https://openstax.org/books/calculus-volume-1/

CO	CO Description	PO	PSO
CO1	Apply the concepts of limits, continuity and derivatives to analyze functions and solve optimization problems.	PO1(3) PO2(2)	PSO1(2) PSO2(1)
CO2	Analyze functions of several variables using partial derivatives, Taylor's formula and optimization techniques.	PO1(3) PO2(3)	PSO1(2) PSO2(2)
CO3	Apply integration techniques to evaluate single, double and triple integrals.	PO1(3) PO2(2)	PSO1(2) PSO2(1)
CO4	Determine eigenvalues and eigenvectors of matrices and apply the Cayley–Hamilton theorem to solve matrix problems.	PO1(3) PO2(2)	PSO1(2) PSO2(2)
CO5	Analyze matrices and quadratic forms using orthogonal transformations and determine the nature of quadratic forms.	PO1(3) PO2(3) PO5(2)	PSO1(2) PSO2(2) PSO3(1)

(1) = Low; (2) = Medium; (3) = High

26PHC01	Engineering Physics	L	T	P	C
		3	0	2	4

Course Objective:
To impart essential physics concepts and demonstrate their relevance to diverse engineering applications.

Unit I	Fundamental & Properties of Matter	9

Concept – Force, Mass & Weight, Velocity & Acceleration, Momentum & Impulse, Elasticity – Cantilever-Young's modulus (non-uniform bending), Viscosity- Stokes method - Surface tension - Drop weight method – bimetallic Strip-Thermal Stress-Expansion joints and examples.
Suggested Activities: Virtual demonstration of thermal stress.

Unit II	Thermodynamics	9

Thermal conductivity – Modes of heat transfer- Conductivity of bad conductor, Lee's disc method – Conductivity of good conductor Forbes' Method. Conductivity of semiconductor- laws of Thermodynamics – Entropy- Carnot's cycle as heat engine and refrigerator.
Suggested Activities: Virtual demonstration of four-stroke engine.

Unit III	Optics	9

Fiber Optics: Structure of fiber, fiber optics, communication fiber sensor, Displacement sensor, and pressure sensor & temperature sensor- Interference: constructive and destructive interference -Air Wedge-Determination of thin wire. Michelson's Interferometer - Determination of thin film.
Suggested Activities: Demonstration of optical fiber communication and study of fiber optic sensors.

Unit IV	Quantum Physics	9

Concept – DE Broglie wave equation – Dual nature of matter waves - Properties of matter waves, Schrodinger Time dependent wave equation and Time independent wave equation, Particle in one dimensional box, Photo electric effect - Experimental verification of photo electric effect.
Suggested Activities: Demonstration and analysis of the photoelectric effect and quantum phenomena.

Unit V	Laser and its Application	9

Properties- Einstein Co-Efficient A and B, Ratio of stimulated and spontaneous emission construction, working. Solid laser (Nd-YAG Laser), Gas laser (CO_2), Dye laser, Diode laser (hetero junction and homo junction laser) Advantage industrial and medical application.
Suggested Activities: Demonstration of laser characteristics and study of industrial and medical applications of lasers.

TOTAL (Theory): 45 PERIODS

List of Experiments:

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia
2. Non-uniform bending - Determination of Young's modulus
3. Uniform bending –Determination of young's modulus
4. Determination of band gap of semiconductor using post office box
5. Air wedge - Determination of thickness of a thin sheet/wire
6. Photoelectric effect-verification of electron flow
7. Laser- Determination of the wavelength of the laser using grating

TOTAL (Lab.): 30 PERIODS
TOTAL: 75 PERIODS

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%.

Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%).

Text Books:

1. M. N. Avadhanulu and P. G. Kshirsagar, A Textbook of Engineering Physics, S. Chand Publishing, 11th Edition, New Delhi.
2. R. K. Gaur and S. L. Gupta, Engineering Physics, 8th Edition, Dhanpat Rai Publications, New Delhi.

References:

1. A. K. Sawhney and Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation, Dhanpat Rai & Co., New Delhi. 14th Edition, 2017; Revised Edition 2020.
2. A. Ghatak and K. Thyagarajan, Optical Electronics and Fibre Optics, Cambridge University Press, Cambridge.
3. Arthur Beiser, Concepts of Modern Physics, 6th Edition, 2006, McGraw-Hill Education, New Delhi.
4. S. O. Pillai, Solid State Physics, 10th Edition, New Age International Publishers, New Delhi.
5. K. R. Nambiar, Lasers: Principles, Types and Applications, New Age International Publishers, New Delhi. 1st Edition, 2004/2006 catalogue records.

E-resources:

1. Barrier penetration problem and Quantum tunnelling: https://archive.nptel.ac.in/courses/115/104/115104096/
2. EM waves and wireless channelling: https://onlinecourses.nptel.ac.in/noc24_ee31/preview
3. Bimetallic Strips _ https://www.youtube.com/watch?v=WZQ8lvxdzDk

CO	CO Description	PO	PSO
CO1	Explain the fundamental principles of mechanics and the physical properties of materials**.**	PO1(3) PO2(2) PO3(1)	PSO1 (3)
CO2	Describe the basic concepts of thermodynamics, thermal conductivity and the Carnot cycle**.**	PO1(3) PO2(2) PO3(2)	PSO1 (3)
CO3	Apply the concepts of fiber optics and optical sensors in engineering applications and analyze interference phenomena.	PO1(3) PO2(3) PO4(2)	PSO1 (3)
CO4	Understand the basic principles of quantum mechanics and relate them to modern technological applications.	PO1(3) PO2(3) PO3(2)	PSO1 (3)
CO5	Analyze the operating principles of lasers and identify their applications in science and engineering.	PO1(3) PO2(2)	PSO1 (3)

(1) = Low; (2) = Medium; (3) = High

26CYC01	Engineering Chemistry	L	T	P	C
		3	0	2	4

Course Objectives:

- Understand the fundamental principles and technological requirements of water treatment.
- Acquire knowledge of the basics of polymers, including their preparation, properties, and applications.
- Gain familiarity with renewable and non-renewable energy resources and various energy storage devices used in engineering applications.
- Understand the mechanisms of metal corrosion and the methods used for its prevention and protection in engineering applications.
- Develop an understanding of nanomaterials, their properties, and their applications.

Unit I **Water Technology** **9**

Introduction-sources and impurities in water-soft and hard water- water quality parameters. Types of hardness. - Determination of hardness by EDTA method. Domestic water treatment. Boiler feed water –requisites - scale and sludge formation in boilers-caustic embrittlement- boiler corrosion- treatment of boiler feed water. Internal conditioning (carbonate, phosphate, and calgon conditioning) - external conditioning – ion exchange process, zeolite process, Brackish water –water purification by reverse osmosis.

Suggested Activities: Coagulation of water sample using Alum.

Unit II **Polymer Chemistry** **9**

Introduction - occurrence, definitions – functionality - degree of polymerization-, molecular weight - number and weight average method. Types of polymerizations - addition, condensation and copolymerization. Mechanism of polymerization (Free radical). Preparation - properties and applications of nylon 66, Poly Urethane, poly isoprene and Vulcanization of rubber, TEFLON, PET.

Suggested Activities: Preparation of Biodegradable Polymer/Polymer Demonstration.

Unit III **Energy Resources and Storage Devices** **9**

Non - renewable energy - nuclear energy, nuclear reaction and its types. Nuclear power plant and its working (light water nuclear power plant & breeder reactor). Renewable energy and its sources. Recent advances in solar cell materials. Geothermal Energy and different type of geothermal power plants. Batteries and Fuel cells- Types of batteries - lead storage battery, lithium battery. Fuel cell - H_2-O_2 fuel cell-applications.

Suggested Activities: Performance Study of a Solar Cell.

Unit IV **Corrosion and its Control** **9**

Introduction- types of corrosion - chemical and electrochemical corrosion- galvanic corrosion- pitting corrosion- crevice corrosion- corrosion on wire fence and pipeline corrosion-factors influencing rate of corrosion. Corrosion control methods – sacrificial anode and impressed cathodic current. Protective coatings – paints: constituents and functions.

Suggested Activities: Demonstration of Corrosion and Its Prevention.

Unit V **Nano Chemistry** **9**

Basics- distinction between molecules, nanoparticles and bulk materials, Size dependent properties. Nanoparticles: nanocluster- nanorod- nanotube (CNT) and nanowires. Synthesis- Top down process- chemical vapour deposition- electro deposition. Electro spinning method. Bottom up process- precipitation, sol-gel, solvothermal - properties and applications of nanomaterials in various fields.

Suggested Activities: Synthesis/Demonstration of Nanomaterials.

TOTAL (Theory) : 45 PERIODS

List of Experiments:

1. Determination of Total, Temporary and Permanent hardness of water by EDTA Method.
2. Estimation of Alkalinity in water sample.
3. Determination of HCl using NaOH by pH metry
4. Estimation of Ferrous iron by Potentiometric titration.
5. Estimation of HCl using NaOH by Conductometric titration
6. Estimation of Dissolved Oxygen content in water by Winkler's method
7. Determination of Chloride in water by Argentometric method
8. Estimation of copper content of the given solution by Iodometry.
9. Estimation of TDS of a water sample by gravimetry.

10. Determination of strength of acids in a mixture of acids using conductivity meter. **TOTAL (Lab.): 30 PERIODS** **TOTAL: 75 PERIODS**
Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%.
Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%).
Text Books:
1. Dr.S.Mageswari, Dr.K.Balachandran, Dr.G.Vijayakumar, "Engineering Chemistry" Tata McGraw Hill Pvt. Ltd., 1st Edition-2024. 2. O.G.Palanna, "Engineering Chemistry" Tata McGraw Hill Pvt. Ltd., 2nd Edition -2017
References:
1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Text book of Quantitative Chemical Analysis, 6th Edition (2000). 2. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company Pvt. Ltd., 2025. 3. Arun Bahl, B.S. Bahl, G.D. Tuli, "Essentials of Physical Chemistry**"** Published by S. Chand & Company Ltd., 2014 4. Sashi Chawla, Dhanpat Rai & Co. Pvt. Ltd., "Engineering Chemistry" 5th Edition - 2017. 5. Dr.S.Vairam, Dr.Suba Ramesh, "Engineering Chemistry", 1st Edition, Wiley Publication, Reprint-2016.
E-resources:
1. https://nptel.ac.in/courses/ 2. https://swayam.gov.in/ 3. https://www.chemguide.co.uk/

CO	CO Description	PO	PSO
CO1	Explain the principles of water technology, water treatment methods, and boiler feed water conditioning for industrial applications.	PO3(3)	PSO1(2)
CO2	Apply the concepts of polymer chemistry to classify polymers and relate their preparation, properties, and engineering applications.	PO3(3) PO6(2)	PSO2(3)
CO3	Analyze renewable and non-renewable energy resources, energy storage devices, and fuel cells for sustainable energy applications.	PO6(3)	PSO1(3)
CO4	Analyze the mechanisms of corrosion and recommend suitable corrosion prevention and protective coating techniques for engineering systems.	PO2(2) PO3(2) PO6(2)	PSO2(3)
CO5	Evaluate the synthesis methods, properties, and applications of nanomaterials in medical and electronic devices.	PO2(3)	PSO1(3) PSO2(2)

(1) = Low; (2) = Medium; (3) = High

26EEC02	Basic Electronics and Electrical Engineering	L	T	P	C
		3	0	0	3

Course Objective:

To impart foundational knowledge in principles and applications of electrical and electronics engineering.

Unit I	Basic Electronics	9

Passive and active components – Resistors, Capacitors, Inductors-Types, features and specification, Energy band diagram of conductors, semiconductor and insulator – Intrinsic & extrinsic semiconductor - types. PN junction diode – zener diode.

Suggested Activities: VI characteristics of PN junction and Zener diode.

Unit II	Electrical Machines	9

Electrical Machines: Construction, Principle of Operation, Basic Equations and Applications - DC Generators, DC Motors, Single Phase Transformer, Single phase Induction Motor, Three phase Induction Motor, Three phase Alternator, Stepper and BLDC motors.

Suggested Activities: Demonstration of Electrical Machines.

Unit III	Measurements and Instrumentation	9

Measurements and Instrumentation: Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

Suggested Activities: Demonstration of measuring equipments.

Unit IV	Basics of Power Systems	9

Basics of Power Systems: Power system structure -Generation, Transmission and distribution , Various voltage levels, Earthing – methods of earthing, protective devicesswitch fuse unit- Miniature circuit breaker- moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

Suggested Activities: Demonstration of Earthing and safety precautions in electrical circuits.

Unit V	Sensors and Transducers	9

Sensors and Transducers Solenoids, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, piezo electric crystals, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

Suggested Activities: Demonstrate the working of proximity sensors, limit switches, Hall-effect sensors, photo sensors, and strain gauges using simple real-life examples.

TOTAL : 45 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (20%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. Hughes, E., Electrical and Electronic Technology, Pearson, 12th Edition, 2016.
2. Theraja, B.L. and Theraja, A.K., A Textbook of Electrical Technology – Volume I, S. Chand & Company Ltd., New Delhi, 2024.

References:

1. Bell, D., Electronic Devices and Circuits, Oxford University Press, 5th Edition, 2008.
2. Tooley, M.A., Electronic Circuits: Fundamentals and Applications, Elsevier Limited, 5th Edition, 2006.
3. Malvino, A. and Bates, D.J., Electronic Principles, 9th Edition, McGraw-Hill Education, 2012.
4. Sawhney, A.K. and Sawhney, P., A Course in Electrical and Electronic Measurements and Instrumentation, 20th Edition, Dhanpat Rai & Co., New Delhi, 2010.
5. Patranabis, D., Sensors and Transducers, PHI Learning Pvt. Ltd, 2nd Edition, New Delhi, 2003.

E-resources:
1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science 2. https://www.khanacademy.org/science/electrical-engineering 3. https://nptel.ac.in/

CO	CO Description	PO	PSO
CO1	Understand and explain basic electrical and electronic concepts.	---	---
CO2	Apply and analyse electrical circuits in real-time applications.	PO1 (3) PO2 (3)	PSO1(3) PSO2(2)
CO3	Apply measurement and instrumentation techniques to measure electrical quantities using appropriate instruments.	PO1 (3) PO2 (3) PO4 (3)	PSO1(3) PSO2(3) PSO3(2)
CO4	Explain the basic structure of power systems, electrical protection and safety practices.	PO1 (3) PO2 (3) PO6 (3)	PSO2(3) PSO3(2)
CO5	Explain the working principles and applications of sensors and transducers used in modern engineering systems.	PO1 (3) PO4 (3) PO5 (3)	PSO1(3) PSO2(3) PSO3(3)

(1) = Low; (2) = Medium; (3) = High

26CSC01	Programming Language: C	L	T	P	C
		3	0	0	3

Course Objectives:

- To equip engineering students with the foundational knowledge and practical skills in 'C' programming to analyses and solve computational problems effectively.
- To faster problem-solving, critical thinking, and modular programming skills essential for engineering domains.

Unit I	Introduction to C& Problem Solving	9

Problem Solving, Problem Analysis Chart, Developing an Algorithm, Flowchart and Pseudo code, program structure, Compilation & Execution process, Interactive and Script mode, Comments, Indentation, Error messages, Primitive data types, Constants, Variables, Reserved words, Operators, Input/output Functions, Built-in Functions.

Suggested Activities:

Solve GATE-style MCQs on algorithms, flowcharts, pseudocode, Interactive and Script mode, Comments, Indentation.

Unit II	Control Structures & Functions	9

If, if-else, nested if, switch-case, while, do-while, for, nested loops, Jump statements. Function Declaration, Definition and Calling, Function Parameters and Return Types, Call by Value and Call by Reference, Recursive Functions, Scope and Lifetime of Variables, Header files and Modular Programming.

Suggested Activities:

Solve GATE-style MCQs on if, if-else, nested if, switch-case, loops, nested loops, and jump statements with output prediction..

Unit III	Arrays, Strings & Pointers	9

One-dimensional and Multi-dimensional Arrays, Array operations and traversals, String Handling: String declaration, input/output, string library functions, Pointer arithmetic, Pointers and Arrays, Pointers to function, Dynamic memory allocation.

Suggested Activities:

Solve GATE-style MCQs on one-dimensional and multi-dimensional arrays, array operations, traversals, and string handling with output prediction.

Unit IV	Structures & Unions	9

Defining and using structures, Array of structures, Sorting an array of structures, Difference between structures and unions, Pointers to structures, Unions and their uses, Unions with pointers, Enumerations.

Suggested Activities:

Analyze GATE-style MCQs on structures, arrays of structures, sorting, and pointers to structures.

Unit V	File operations & Standard Libraries	9

Open, read, write, close file operations, Binary vs Text files, File pointers, Error handling in file operations. Using standard libraries like stdio.h, stdlib.h, string.h, math.h, Creating and using user-defined header files and libraries.

Suggested Activities: Interpret GATE-style MCQs on file operations, text and binary files, file pointers, and error handling.

TOTAL (Theory) : 45 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. Thareja, R. (2021). Programming in C, 3rd Edition, Oxford University Press.
2. Balagurusamy, E. (2024). Programming in ANSI C, 9th Edition, Tata McGraw Hill.

References:

1. Kanetkar, Y. (2020). Let us C, 21st Edition, BPB Publications.
2. Kalicharan, N. (2022). Learn to program with C: An introduction to programming using the C language. A

press.
3. Forouzan, B. A., & Afyouni, H. (2023). Computer science: A structured programming approach in C, 4th Edition, Cengage.
4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press, 2013.
5. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.

E-resources:

1. Learn-C.org - https://www.learn-c.org/
2. Geeks for Geeks - C Programming - https://www.geeksforgeeks.org/c-programming-language/
3. GNU C Library Documentation - https://www.gnu.org/software/libc/manual/"Introduction to C Programming", Swayam MOOC Course,

CO	CO Description	PO	PSO
CO1	Develop algorithms, flowcharts, and basic C programs for problem solving.	PO1 (3) PO2 (2)	PSO1 (3)
CO2	Implement control structures, functions, and modular programming in C.	PO2 (3) PO5 (2)	PSO1 (3)
CO3	Apply arrays, strings, pointers, and dynamic memory allocation in C programming.	PO2 (2) PO3 (3) PO5 (2)	PSO1 (3) PSO2 (2)
CO4	Construct C programs using structures and unions.	PO3 (3) PO5 (3)	PSO1 (3) PSO2 (3)
CO5	Develop C applications using file handling techniques, standard libraries, user-defined libraries and mini projects.	PO3 (3) PO5 (3) PO9 (2)	PSO1 (3) PSO2 (3)

(1) = Low; (2) = Medium; (3) = High

26MEC02	Makerspace Laboratory	L	T	P	C
		0	0	4	2

Course Objectives:

- To impart practical skills in the assembly, disassembly, and welding of components using appropriate tools and techniques.
- To provide hands-on training in electrical wiring practices, and the use of electronic components, sensors, and actuators.

List of Suggested Activities:

(A). Dis-assembly & Assembly Practices

i. Tools and its handling techniques.
ii. Dis-assembly and assembly of home appliances – Grinder Mixer Grinder, Ceiling Fan, Table Fan & Washing Machine.
iii. Dis-assembly and assembly of Air-Conditioners & Refrigerators.
iv. Dis-assembly and assembly of a Bicycle.

(B). Welding Practices

i. Welding Procedure, Selection & Safety Measures.
ii. Power source of Arc Welding – Gas Metal Arc Welding & Gas Tungsten Arc Welding processes.
iii. Hands-on session of preparing base material & Joint groove for welding.
iv. Hands-on session of MAW, GMAW, GTAW on Carbon Steel & Stainless Steel plates /pipes for fabrication of a simple part.

(C). Electrical Wiring Practices

i. Electrical Installation tools, equipment & safety measures.
ii. Hands-on session of basic electrical connections for Fuses, Miniature Circuit Breakers and Distribution Box.
iii. Hands-on session of electrical connections for Lightings, Fans, Calling Bells.
iv. Hands-on session of electrical connections for Motors & Uninterruptible Power Supply.

(D). Electronics Components / Equipment Practices

i. Electronic components, equipment & safety measures.
ii. Dis-assembly and assembly of Computers.
iii. Hands-on session of Soldering Practices in a Printed Circuit Board.
iv. Hands-on session of Bridge Rectifier, Op-Amp and Trans impedance amplifier.
v. Hands-on session of integration of sensors and actuators with a Microcontroller.
vi. Demonstration of Programmable Logic Control Circuit.

(E). Contemporary Systems

i. Demonstration of Solid Modelling of components.
ii. Demonstration of Assembly Modelling of components.
iii. Fabrication of simple components / parts using 3D Printers.
iv. Demonstration of cutting of wood / metal in different complex shapes using Laser Cutting Machine.

TOTAL : 60 PERIODS

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Observation and Record (20%), Practical (30%), Internal Examinations (50%)

Text Books:

1. S. K. Hajra Choudhury, A. K. Hajra Choudhury and S. K. Bhattacharya, Elements of Workshop Technology – Volume I: Manufacturing Processes, 16th Edition, Media Promoters & Publishers, Mumbai.
2. R. S. Khurmi and J. K. Gupta, A Textbook of Workshop Technology – Manufacturing Processes, 6th Edition, S. Chand Publishing, New Delhi.

References:

1. P. N. Rao, Manufacturing Technology: Foundry, Forming and Welding, 4th Edition, 2017, McGraw Hill Education, New Delhi.
2. S. Kalpakjian and S. R. Schmid, Manufacturing Engineering and Technology, 9th Edition, 2025, Pearson Education, New Delhi.
3. B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology – Volume I, S. Chand Publishing, New Delhi. 2024 Edition.
4. David P. Leach, Electrical and Electronic Technology, McGraw Hill Education, New Delhi.
5. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 7th Edition, 2019, Wiley, New Delhi.

CO	Description of CO	PO	PSO
CO1	Demonstrate proper use and handling of tools and perform disassembly and assembly of mechanical systems, home appliances and bicycles.	PO1(3) PO5(3) PO8(2)	PSO1(3)
CO2	Perform welding and fabrication of simple components using suitable welding processes, materials, tools and safety practices.	PO1(3) PO3(3) PO5(3) PO7(3)	PSO1(3) PSO2(3)
CO3	Carry out basic electrical wiring and connections for domestic and industrial applications using appropriate electrical equipment and safety procedures.	PO1(3) PO5(3) PO7(3)	PSO2(2) PSO3(2)
CO4	Demonstrate electronic assembly, soldering, circuit implementation and integration of sensors, actuators and microcontrollers for practical applications.	PO1(3) PO2(3) PO5(3) PO8(3) PO11(3)	PSO2(3) PSO3(3)
CO5	Apply contemporary engineering tools for solid and assembly modelling, 3D printing and laser cutting to develop simple components.	PO3(3) PO5(3) PO11(3)	PSO1(3) PSO2(3) PSO3(2)

(1) = Low; (2) = Medium; (3) = High

26CSC02	Programming in C Laboratory	L	T	P	C
		0	0	4	2

Course Objectives:

- To familiarize with C programming constructs.
- To develop programs in C using basic constructs.
- To develop programs in C using arrays.
- To develop applications in C using strings, pointers, functions.
- To develop applications in C using structures.
- To develop applications in C using file processing.

Note: The lab instructor is expected to design problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.

1. Create Problem Analysis Charts, Flowcharts and Pseudo code for simple C programs
2. I/O statements, operators, expressions.
3. Decision-making constructs: if-else, go to, switch-case, break-continue.
4. Loops: for, while, do-while.
5. Arrays: 1D and 2D, Multi-dimensional arrays, traversal.
6. Strings: operations.
7. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
8. Recursion.
9. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
10. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
11. Files: reading and writing data in text and binary files, File pointers, file operations, random access and processor directives.
12. Use of standard and user-defined libraries in solving problems.

TOTAL : 60 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Observation and Record (20%), Practical (30%), Internal Examinations (50%)

Text Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2nd Edition, Prentice Hall.
2. E. Balagurusamy, Programming in ANSI C, 8th Edition, McGraw Hill Education, New Delhi.

References:

1. Thareja, R. (2021). Programming in C .3rd Edition, Oxford University Press.
2. Balagurusamy, E. (2019). Programming in ANSI C, 9th Edition, McGraw Hill Education.
3. Kanetkar, Y. (2020). Let us C, 21st Edition, BPB Publications.
4. Kalicharan, N. (2022). Learn to program with C: An introduction to programming using the C language. Apress.
5. Forouzan, B. A., & Afyouni, H. (2023). Computer science: A structured programming approach in C, 4th Edition, Cengage.

E-resources:

1. Learn-C.org - https://www.learn-c.org/
2. Geeks for Geeks - C Programming - https://www.geeksforgeeks.org/c-programming-language/
3. GNU C Library Documentation - https://www.gnu.org/software/libc/manual/

CO	CO Description	PO	PSO
CO1	Develop algorithms, flowcharts, and basic C programs for problem solving.	PO1 (3) PO2 (2)	PSO1 (3)
CO2	Implement control structures, functions, and modular programming in C.	PO2 (3) PO5 (2)	PSO1 (3)
CO3	Apply arrays, strings, pointers, and dynamic memory allocation in C programming.	PO2 (2) PO3 (3) PO5 (2)	PSO1 (3) PSO2 (2)
CO4	Construct C programs using structures and unions.	PO3 (3) PO5 (3)	PSO1 (3) PSO2 (3)
CO5	Develop C applications using file handling techniques, standard libraries, user-defined libraries and mini projects.	PO3 (3) PO5 (3) PO9 (2)	PSO1 (3) PSO2 (3)

(1) = Low; (2) = Medium; (3) = High

26HSC02	Physical Education	L	T	P	C
		-	-	-	-

Course Objectives:

- To impart the fundamentals of physical education for the development of students' physical, mental, and social well-being.
- To instil a lifelong appreciation for physical activity, develop a positive attitude, and foster the values of teamwork and sportsmanship.

Introduction to physical education: Exercise for good posture – conditioning and calisthenics before starting physical activities – jogging, bending, twisting, standing, sitting, and relaxation exercises – training in basic first-aid practices.

Participation of athletic events: Rules and regulations of important athletic events – sprints, jumps, throws, and hurdles.

Skill development in any one of the following outdoor games: Basket Ball, Volley Ball, Ball Badminton, Football, Hockey, Kho-Kho, Kabaddi, Cricket, Hand ball and Tennis.

Skill development in any one of the following indoor games: Shuttle Badminton, Chess and Table Tennis.

TOTAL: 30 PERIODS

References:

1. Ajmer Singh, Essentials of physical education. Kalyani Publishers, 7th Revised Edition, 2025.
2. Kamlesh,M.L.(2006).Psychology in physical education and sports, 3rd Edition, Metropolitan Book Co.
3. S.K. Mangal & Shubhra Mangal: Sports Psychology: Concepts and Applications, 1st Edition, "Psychology of Sports Performance" 2024, Routledge India.

E-resources:

1. https://www.who.int/health-topics/physical-activity

CO	CO Description	PO	PSO
CO1	Demonstrate appropriate physical exercises, conditioning, calisthenics, posture, relaxation techniques and basic first-aid practices for maintaining physical fitness and safety.	PO1(2) PO4(2) PO7(3)	PSO3(2)
CO2	Demonstrate knowledge of rules and regulations and apply fundamental skills in athletic events including sprints, jumps, throws and hurdles.	PO7(2) PO8(3)	PSO3(2)
CO3	Develop and demonstrate fundamental skills, techniques and game strategies in a selected outdoor game through regular practice and teamwork.	PO2(2) PO3(2) PO5(2) PO7(2) PO8(3)	PSO3(3)
CO4	Develop and demonstrate fundamental skills, techniques and strategies in a selected indoor game with emphasis on concentration, discipline and fair play.	PO2(2) PO7(3) PO9(2)	PSO3(2)
CO5	Apply physical fitness, sports skills, teamwork, discipline, ethical values and safety practices to promote a healthy and active lifestyle.	PO6(3) PO7(3) PO8(3) PO11(3)	PSO3(3)

(1) = Low; (2) = Medium; (3) = High

SEMESTER – II

26MAC02	Linear Algebra	L	T	P	C
		3	1	0	4

Course Objectives:

- To impart foundational knowledge in linear algebra essential for analyzing and solving problems in engineering applications.
- The Objectives of the course are to equip students with the ability to formulate and solve various types of Ordinary Differential Equations for solving differential equations encountered in engineering problems.

Unit I	Vector Spaces	12

Introduction to Vector Spaces, Examples, Subspaces, Linear Combinations, Span, Generating Sets, Linear Dependence and Independence, Basis and Dimension.

Suggested Activities: Open-Source software, exercises to test linear dependence and independence using rank, solving Competitive Examination questions

Unit II	Inner Product Spaces	12

Inner product, Norms, Cauchy, Schwarz inequality, Gram-Schmidt orthogonalization, Simple problems (up to $\boldsymbol{R^3}$).

Suggested Activities: Open-Source software, exercises to compute inner products and vector norms, solving Competitive Examination questions.

Unit III	Matrix Decomposition	12

QR decomposition (Gram- Schmidt method and House holder method), Singular Value Decomposition (SVD), Least squares solutions, simple problems (up to 3×3 *matrices*).

Suggested Activities: Open-Source software, exercises to check if a matrix is positive definite, solving Competitive Examination questions.

Unit IV	First order Ordinary Differential Equations	12

Basic concepts of ordinary differential equations, Formation of first order differential equations from physical problems, First order and first-degree ODE: Variables separable, Exact equations, Leibnitz's equation, Bernoulli's equation.

Suggested Activities: Application and Visualization of the first order ODE using open-source software and solving Competitive Examination questions.

Unit V	Higher order Ordinary Differential Equations	12

Formation of second order differential equations from physical problems Linear equations of second and higher order with constant coefficients, Euler's linear equations, Method of variation of parameters.

Suggested Activities: Solving ordinary differential equations using open-source software and solving of Competitive Examination questions.

TOTAL : 60 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. Friedberg, S. H., Insel, A. J., & Spence, L. E. (2022). Linear algebra. 5th Edition, Pearson.
2. Boyce, W. E., DiPrima, R. C., & Meade, D. B. (2022). Elementary differential equations and boundary value problems, 12th Edition, Wiley.

References:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 45th Edition, 2026.
2. Lay, D. C., Lay, S. R., & McDonald, J. J. (2020). Linear algebra and its applications with MATLAB, 6th Edition, Pearson.
3. Bronson, R., Costa, G. B., Saccoman, J. T., & Gross. D (2023). Linear algebra: Algorithms, applications, and techniques, 4th Edition.
4. Lay, D. C., Lay, S. R., & McDonald, J. J. (2021). Linear algebra and its applications, 6th Edition, Pearson
5. Kreyszig, E. (2025). Advanced engineering mathematics, 11th Edition, Wiley.

E-resources:

1.https://math.libretexts.org/Bookshelves/Linear_Algebra/Book%3A_Linear_Algebra_(Schilling_Nachtergaele_and_Lankham)/09%3A_Inner_product_spaces
2. https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/
3. https://archive.nptel.ac.in/content/syllabus_pdf/111106063.pdf

CO	CO Description	PO	PSO
CO1	Explain the fundamental concepts of Linear Algebra.	PO1(3)	PSO1(2)
CO2	Compute inner products and vector norms, validate the Cauchy-Schwarz inequality	PO1(3)	PSO1(2)
CO3	Factorize matrices using QR decomposition to solve physical least-squares approximation problems.	PO1 (3)	PSO1(1)
CO4	Explain first and higher-order ODEs using appropriate analytical and numerical techniques.	PO1 (2) PO2 (2)	PSO3(1)
CO5	Solve higher-order ODEs using classical and finite Difference methods.	PO1(3) PO5(3)	PSO1(2)

(1) = Low; (2) = Medium; (3) = High

26PHC07	Medical Physics	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart fundamental knowledge of rigid body dynamics, crystalline physics and functional materials
- To provide analytical abilities for evaluating physical phenomena in mechanical engineering applications.

Unit I	Crystalline Physics	9

Crystal Structure-Crystal lattice - unit cell-lattice Parameter-Crystal system and Bravais lattice structure and Packing fraction of SC, BCC, FCC, crystalline and Non Crystalline material with example, Crystalline planes - Miller indices-procedure and example. Interplanar distance between two successive planes.

Suggested Activities: Demonstration of crystal structures (SC, BCC and FCC) using 3D models and determination of Miller indices for selected crystal planes.

Unit II	Inertia And Dynamics of Rigid Body	9

Concept-inertia- center of mass - rigid body- rotational kinetic energy and momentum of inertia – parallel and perpendicular axis theorem- moment of inertia of disc, solid cylinder, hollow cylinder, solid sphere and hollow sphere and Gear function.

Suggested Activities: Demonstration of moment of inertia of a gear and study of its rotational motion.

Unit III	Properties of Magnetic Material	9

Classification –Dia, para, and Ferro. Bohr magnetron – origin of ferromagnetism – Domain theory – Anti-Ferro – Ferro magnetism – Properties, Hard and soft magnetic material-principles of magnetic recording- Magnetic hard disc (GMR Sensor). Quantum interference devices.

Suggested Activities: Experimental demonstration of magnetic susceptibility using Quincke's method and classification of magnetic materials.

Unit IV	Optical Material	9

Classification of Optical material, - Optical process in semiconductor, Optical absorption and emission-Scattering, effect- Optical process in conductor and insulator –LED-Solar cell –Optical process in organic semiconductor (OLED)-laser diode (Hetero and homo)-Excitonic states.

Suggested Activities: Experimental study of LED and solar cell characteristics and their optical applications.

Unit V	Functional Material	9

Composite-fiber reinforced plastics (FRP), Fiber reinforced metal (FRM) Metallic glass-quenching process, application, Shape memory alloy (SMA)-Process of application-crystalline and non-crystalline material – Ceramics-properties -isostatic pressing methods- applications

Suggested Activities: Demonstration of shape memory effect in SMA and study of applications of functional materials such as FRP, FRM, metallic glass and ceramics.

TOTAL : 45 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. A. J. Dekker, Solid State Physics, Macmillan India Limited, New Delhi.
2. S. O. Pillai, Solid State Physics, 10th Edition, New Age International Publishers, New Delhi, 2020.

References:

1. V. Raghavan. Materials Science and Engineering: A First Course, 6th Edition, Prentice Hall India Learning Private Limited, 2015.
2. Mathur, D. S. (2008). Elements of properties of matter. S. Chand.
3. S.O. Kasap, Principles of Electronic Materials and Devices, 4th Edition, Mc-Graw Hill, 2018.
4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, 1st Edition, Mc-Graw Hill India (2019)
5. Donald R. Askeland & Wendelin J. Wright, The Science and Engineering of Materials, 7th Edition, Cengage Learning.

E-resources:

1. Crystalline physics:https://ocw.mit.edu/courses/3-091sc-introduction-to-solid-state-chemistry-fall-2010/pages/crystalline-materials/15-introduction-to-crystallography/
2. Moment of Inertia: https://youtu.be/fDJeVR0o_-w
3. Magnetic Susceptibility – https://em-amrt.vlabs.ac.in/exp/quinckes-method

CO	CO Description	PO	PSO
CO1	Explain the fundamentals of electromagnetic radiation, light and non-ionizing radiation and their medical applications.	PO1(3) PO2(2) PO3(2) PO4(2)	PSO1(3) PSO2(2)
CO2	Explain radioactive decay, radioisotopes, radionuclide production and their applications in medicine.	PO1(3) PO2(2) PO4(2) PO5(2)	PSO1(3) PSO2(3)
CO3	Analyze the interaction of charged particles, X-rays, gamma rays and neutrons with matter and their clinical significance.	PO1(3) PO2(3) PO4(3) PO5(2)	PSO1(3) PSO2(3) PSO3(3)
CO4	Explain radiation dose, exposure, dosimetric quantities and biological effects of ionizing radiation.	PO1(3) PO2(3) PO4(3) PO6(3) PO7(3)	PSO1(3) PSO2(3) PSO3(3)
CO5	Explain the principles of sound and ultrasound and their applications in medical diagnosis.	PO1(3) PO3(3) PO5(3)	PSO1(3) PSO2(3) PSO3(3)

(1) = Low; (2) = Medium; (3) = High

26GEC01	Environmental Science and Sustainability	L	T	P	C
		2	0	0	2

Course Objectives:

- To understand environment, ecosystems, biodiversity, and conservation.
- To understand sustainability, SDGs, and environmental issues.
- To learn sustainable practices, circular economy, and green engineering.
- To understand pollution, prevention, control, and waste management.
- To learn energy conservation and renewable energy sources

Unit I	Environment and Biodiversity	6

Nature and scope of environmental education, natural resources, Ecosystem Structure, characteristics and functions of ecosystem. Biodiversity, definition, conservation of biodiversity (in-situ and Ex-situ).
Suggested Activities: Know Your Campus Biodiversity & Campus Biodiversity Survey.

Unit II	Social Issues and Sustainability	6

Sustainability, Definition, Sustainable development Goals, Environmental issues - global warming and Ozone depletion ,Climate change, Acid rain, Carbon foot print-Possible solutions to Environmental issues.
Suggested Activities: Sustainability Action Challenge & Sustainability Action Plan.

Unit III	Sustainability Practices	6

Zero waste and R-concept-circular economy, material life cycle assessment, Sustainable habitat - Sustainable transports, Sustainable urbanization, Green Engineering, Green buildings, Green materials- GRIHA- IGBC Green & Net Zero Buildings Rating System.
Suggested Activities: Unsustainable Campus Challenge – "From Waste to Resource Green Campus" solution.

Unit IV	Environmental Pollution and Its Control	6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Environmental protection, Environmental protection acts.
Suggested Activities: Environmental Pollution Audit and Control Plan, Prepare a Pollution Control Chart.

Unit V	Renewable Sources of Energy	6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources. Concept, origin and power plants of geothermal energy.
Suggested Activities: Comparative Study of Renewable Energy Sources, Design a Renewable Energy Syllabus.

TOTAL : 30 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
2. G. Tyler Miller and Scott E. Spoolman, Environmental Science, 15th Edition, Cengage Learning, Boston.

References:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 3rd Edition, Pearson Education, 2023.
3. P. Meenakshi – Elements of Environmental Science and Engineering, 2nd Edition, latest print 2023, PHI Learning
4. Jay H. Withgott & Matthew Laposata – Essential Environment: The Science Behind the Stories, 7th Edition, Pearson.
5. Cunnighum and cooper-"Environmental Science, Jaico", The current Cunningham environmental-science text is 16th Edition, 2026, McGraw Hill

E-resources:

1. https://nptel.ac.in/courses/103107215

CO	CO Description	PO	PSO
CO1	Explain environmental concepts, ecosystems, biodiversity, and conservation.	PO6(3)	PSO3(3)
CO2	Describe sustainability, SDGs, environmental issues, and solutions.	PO7(3)	PSO2(3)
CO3	Apply sustainable practices, circular economy, green engineering, and green buildings.	PO6(3) PO7(3)	PSO1(3)
CO4	Identify pollution causes, effects, control measures, and waste management practices.	PO3(3) PO6(3)	PSO2(3)
CO5	Explain energy conservation and emerging renewable energy sources.	PO6(3)	PSO1(3) PSO2(2)

(1) = Low; (2) = Medium; (3) = High

26BM201	Biosciences for Medical Engineering	L	T	P	C
		3	0	2	4

Course Objective:

To impart knowledge in biosciences by dealing with various aspects of biochemical reactions of biomolecules, importance of immunological defense system in human wellbeing and influence of microbes in universal system.

Unit I	Introduction to Biochemistry	9

Structure of water and its significance, importance of covalent and noncovalent bonds. Acid- base maintenance and the role of biological buffers in p H maintenance. Henderson- Hassel Balch equation. Disorders associated with acid- base imbalance. Principles of viscosity, surface tension, adsorption, diffusion, osmosis and their contribution in biological systems.

Suggested Activities: The Molecular Matrix (Water & Bonding)

Unit II	Complex Organic Molecule	9

Carbohydrates-General classification, structure and functions. Carbohydrate metabolism -glycolysis and hormonal regulation. Lipid-structure and functions. Lipid metabolism- triglyceride formation and degradation. Lipoproteins chemistry and types. Protein- structure and functions. Abnormalities- Diabetes mellitus, hypercholesterolemia and phenylketonuria.

Suggested Activities: Visit to clinical laboratory for automation in clinical analysis.

Unit III	Immunology	9

Cells and organs of Immune system, innate and adaptive Immunity. Antigenicity, epitopes, antigen presenting cells. Antibody- structure, function and its isotypes. Recombinant antibodies, monoclonal antibodies in cancer treatment and autoimmune disorders. Cell and humoral mediated immunity. Hypersensitivity and its types. Immunotherapeutic and its applications.

Suggested Activities: POster presentation on immunological diseases.

Unit IV	Microbiology	9

Microscopy- Principles and working of fluorescence microscope, confocal microscope, Electron Microscopes - TEM and SEM. Microbial culturing, inoculation and culture media, growth curve of microbes, identification of microbes. Staining methods- simple staining, differential staining, acid fast staining, negative staining and hematoxylin and eosin staining.

Suggested Activities: Case study presentation on differential staining

Unit V	Pathology	9

Cell injury-reversible and irreversible, necrosis, apoptosis, and intracellular accumulations, cellular adaptations of growth and differentiation-atrophy, hypertrophy, hyperplasia, dysplasia, metaplasia. Edema, thrombosis, embolism, Hematological disorders-bleeding disorders, leukemia's, lymphomas.

Suggested Activities: Review of research papers on leukemia's, lymphomas and its impact on human well-being.

TOTAL (Theory): 45 PERIODS

List of Experiments:

1. Estimation of pH and Preparation of Biological Buffer Solutions
2. Determination of Viscosity of Biological Fluids Using Ostwald's Viscometer
3. Qualitative Identification of Carbohydrates, Proteins and Lipids
4. Estimation of Glucose in a Biological Sample by Colorimetric Method
5. Estimation of Total Protein Using Biuret Method
6. Identification of Blood Cells Using Peripheral Blood Smear
7. Study of Antigen–Antibody Reaction by Agglutination Test
8. Observation of Microorganisms Using Simple and Differential Staining Techniques
9. Study of Microbial Growth Using Growth Curve Analysis**.**
10. Microscopic Examination of Normal and Pathological Tissue Sections

TOTAL (Lab.): 15 PERIODS

TOTAL: 60 PERIODS

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%)

Text Books:

1. Rafi M. D., Textbook of Biochemistry for Medical Students, 4th Edition, Universities Press, Hyderabad.

2. Ramzi S. Conran, Vinay Kumar and Stanley L. Robbins, Robbins Pathologic Basis of Disease, 10th Edition, Elsevier, New Delhi.

References:

1. Rafi MD, Text book of Biochemistry for Medical student, 4th Edition, University of Press, 2021.
2. David W Martin, Peter A, Mayes, Victor. W, Rowell, Harpers review of biochemistry, Lange Medical Publications, 2021.
3. Prescott, Harley and Klein, Microbiology, 9th edition, McGraw Hill, 2017.
4. Jenni Punt, Sharon Strangford, Patricia Jones, Judith A Owen, Kubit Immunology, 8th Edition, WH Freeman, 2018.
5.Ramiz S Conran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of diseases," WB Saunders Co. 7th Edition, 2005.

E-resources:

1. www.ncbi.nlm.nih.gov — National Centre for Biotechnology Information (NCBI), National Library of Medicine.
2. www.microbiologyinfo.com — Microbiology Information Portal, providing resources on microbiology, staining methods, microscopy and microbial culture.
3. www.pathologyoutlines.com — Pathology Outlines, providing resources on pathology, cell injury, apoptosis, necrosis, haematological disorders, leukaemia's and lymphomas.

CO	CO Description	PO	PSO
CO1	Explain the fundamental concepts of biochemistry in various engineering applications.	PO1(3) PO2 (2)	PSO1 (3)
CO2	Apply various methods for anlyzing complex organic molecules in human body	PO1(3) PO2 (3) PO3 (3)	PSO2 (2)
CO3	Analyze the immune system and physiological condition using various techniques	PO1(3) PO2(3) PO4(2)	PSO1 (2)
CO4	Understand the principles of microscopy, microbial culturing, identification and staining techniques for biomedical applications.	PO1(3) PO2(3) PO3(2) PO5(2)	PSO2(3)
CO5	Analyze the operating principles of lasers and identify their applications in science and engineering.	PO1(3) PO2(3) PO4(2)	PSO1(3)

(1) = Low; (2) = Medium; (3) = High

26BM202	Anatomy and Physiology	L	T	P	C
		3	0	2	4

Course Objective:
To impart fundamental and practical knowledge in structural and functional of human system.

Unit I	Anatomy and organization of cell	9

Anatomical positions and planes, anatomical movements. Cell structure and organelles, functions of cellular organelles. Origin of membrane potential, resting and action potential. Tissue, Types, Classification, Location. Membrane, Glands, Classification and Functions. Body cavities.
Suggested Activities: Making anatomical models

Unit II	Digestive and urinary systems	9

Organs of Digestive system, Digestion and Absorption. Cartilage structure and functions.
Suggested Activities: Virtual demonstration of animal digestion

Unit III	Sensory system	9

Eye, Layers of Eye, Mechanism of Vision, Errors of Refraction. Ear: Ear Divisions, Mechanism of Hearing, Skin, Layers of Skin, Functions of Skin.
Suggested Activities: Virtual demonstration of functioning of Ear, Eye and Skin.

Unit IV	Cardiovascular system	9

Blood cells and their functions. Blood groups, importance, identification and structure of blood vessels. Structure of heart, function of valves, conducting system of heart, cardiac cycle, circulatory system-coronary, systemic and pulmonary.
Suggested Activities: Virtual demonstration of functioning of Heart.

Unit V	Lymphatic , Respiratory , Nervous and Urinary system	9

Spleen and thymus gland, lymphatic vessels, Organs involved in respiration and its mechanism. Types of respiration - respiratory volumes and recording of respiratory volume.Structure of neuron, Cross Sections of brain, Cortical localizations and functions, Spinal nerve, Tracts of spinal cord and reflex mechanism. Structure of kidney and nephron. Mechanism of urine formation, urinary reflex.
Suggested Activities: Clinical visits.

TOTAL(Theory):45 PERIODS

List of Experiments:

1. Visualization of different types of tissues
2. Ear and Eye function study
3. WBC and RBC differential Count, Identification of Blood Groups
4. Clinical urinary analysis: urea, creatinine and glucose.

TOTAL (Lab.): 15 PERIODS
TOTAL: 60 PERIODS

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%)

Text Books:

1. Vaz, M., & Raj, T. (2020). Guyton & Hall textbook of medical physiology, 15th Edition, Elsevier Health Sciences.
2.Makari, H. K., Gurumurthy, H., & Sowmya, S. V. (2020). A textbook of human physiology. I.K. International Publishing House Pvt. Ltd.

References:

1. Tortora, G. J., & Derrickson, B. (2003). Principles of anatomy and physiology, 16th Edition, John Wiley & Sons.
2. Thibodeau, G. A., & Patton, K. T. (2007). Anthony's textbook of anatomy and physiology, 22nd Edition, Elsevier.
3. Marieb, E. N. (2007). Essentials of human anatomy and physiology, 13th Edition, Pearson Education.
4. Pocock, G., & Richards, C. D. (2009). The human body: An introduction for biomedical and health Sciences, 5th Edition, Oxford University Press.
5. Ganong, W. F. (2015). Review of medical physiology, 27th Edition, McGraw-Hill Education.

E-Resources :
1. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction 2. https://openstax.org/books/anatomy-and-physiology-2e/pages/23-1-overview-of-the-digestive-system 3 .https://openstax.org/books/anatomy-and-physiology-2e/pages/19-introduction.

CO	Description of CO	PO	PSO
CO1	Describe anatomical positions, planes, movements,cell structure, organelles, membrane potential, tissues, membranes, glands, body cavities.	PO1(3) PO2(2) PO3(1) PO4(1)	PSO1(3) PSO2(2)
CO2	Describe the structure and functions of the digestive and sensory systems..	PO1(3) PO2(2) PO3(2) PO4(1)	PSO1(3) PSO2(2)
CO3	Analyze the structure and functions of eyes, ear and layers, functions of skin.	PO1(3) PO2(3) PO3(2) PO4(2)	PSO1(3) PSO2(2)
CO4	Illustrate the structure and functions of the cardiovascular and systems.	PO1(3) PO2(3) PO3(2) PO4(2)	PSO1(3) PSO2(2)
CO5	Analyze the physiological processes of lymphatic respiratory, nervous systems and urinary system.	PO1(3) PO2(3) PO3(2) PO4(3)	PSO1(3) PSO2(3)

(1) = Low; (2) = Medium; (3) = High

26CSC03	Problem Solving using Python Programming	L	T	P	C
		3	0	2	4

Course Objectives:

- To equip engineering students with the foundational knowledge and practical skills in Python programming to analyse and solve computational problems effectively.
- To faster problem-solving, critical thinking, and modular programming skills essential for engineering domains.

Unit I	Introduction to Python Programming	9

Problem Solving, Problem Analysis Chart, Developing an Algorithm, Flowchart and Pseudocode, Interactive and Script Mode, Indentation, Comments, Error Messages, Variables, Reserved Words, Data Types, Arithmetic Operators and Expressions, Built-in Functions, Importing from Packages.

Suggested Activities:

Interpret GATE-style MCQs on pseudocode, interactive/script mode, indentation, comments, errors, variables, reserved words, and data types.

Unit II	Control Structures and Functions	9

If, if-else, Nested if, Multi-way if-elif Statements, while Loop, for Loop, Nested Loops, pass Statements. Functions: Hiding Redundancy and Complexity, Parameters, Arguments and Return Values, Formal and Actual Arguments, Named Arguments, Recursive Functions, Lambda Functions.

Suggested Activities:

Practice GATE-style MCQs on Control Statements, while, for, nested loops, and pass statements.

Unit III	Strings and Collections	9

String Comparison, Formatting, Slicing, Splitting, Stripping. Collections: Lists, Tuples, Sets and Dictionaries, Basic List Operators, Searching and Sorting Lists, Dictionary Literals, Adding and Removing Keys, Accessing and Replacing Values.

Suggested Activities:

Evaluate GATE-style MCQs on string comparison, formatting, slicing, splitting, stripping, lists, tuples, sets, and dictionaries.

Unit IV	File Operations and Data Processing	9

Creating, Opening, Reading, Writing, Appending and Closing Files, Manipulating Directories, OS and Sys Modules, Reading and Writing Text and Numbers, Creating and Reading Formatted Files such as CSV and Tab-Separated Files.

Suggested Activities:

Examine GATE-style MCQs on creating, opening, reading, writing, appending, closing files, directories, and OS/Sys modules.

Unit V	Python Modules, Packages and Project	9

Packages: Built-in Modules, User-Defined Modules, NumPy, SciPy, Pandas and Scikit-learn.

Suggested Activities:

Assess GATE-style MCQs on built-in modules, user-defined modules, and their applications.

TOTAL (Theory) : 45 PERIODS

List of Experiments:

1. Problem Analysis Chart, Flowchart and Pseudocode Practices. (Minimum Three)
2. Usage of Conditional Logics in Programs. (Minimum Three)
3. Usage of Functions in Programs. (Minimum Three)
4. String Manipulation and Operations on Lists, Tuples, Sets and Dictionaries. (Minimum Three)
5. Opening, Closing, Reading and Writing Formatted Files and Sorting Data. (Minimum Three)
6. Usage of Modules and Packages to Solve Engineering Problems. (Minimum Three)
7. Project: Development of Python-based applications using appropriate programming concepts, modules and packages. (Minimum Two Projects)

TOTAL (Lab.): 30 PERIODS
TOTAL: 75 PERIODS

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%.

Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%).
Text Books:
1. Thareja, R. (2023). Python Programming: Using Problem Solving Approach (2nd Edition). Oxford University Press. 2. Liang, Y. D. (2017). Introduction to Programming Using Python (1st Edition). Pearson Education.
References:
1. Matthes, E. (2019). Python crash course: A hands-on, project-based introduction to programming (2nd Edition). No Starch Press. 2. Brown, M. C. (2018). Python: The complete reference (4th Edition). McGraw Hill Publishers. 3. Guttag, J. V. (2016). Introduction to computation and programming using Python: With applications to understanding data (2nd Edition). MIT Press. 4. McKinney, W. (2017). Python for data analysis: Data wrangling with pandas, NumPy, and IPython. Shroff/O'Reilly. 5. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Media, 2016.
E-resources:
1. Official Python Documentation – https://docs.python.org/3/ 2. Python Tutorials – https://www.w3schools.com/python/ 3. NumPy – https://numpy.org/doc/

CO	CO Description	PO	PSO
CO1	Apply problem-solving techniques, algorithms, flowcharts, and Python programming fundamentals to develop simple programs.	PO1 (3) PO2 (3)	PSO1 (3) PSO2 (2)
CO2	Implement conditional, looping, and function construct to develop modular Python programs.	PO1 (3) PO2 (3) PO5 (2)	PSO1 (3) PSO2 (3) PSO3 (2)
CO3	Develop Python programs using strings, lists, tuples, sets, and dictionaries for data manipulation.	PO1 (3) PO2 (3) PO3 (2) PO5 (2)	PSO1 (3) PSO2 (3) PSO3 (2)
CO4	Implement file and directory operations to store, retrieve, process, and organize data in formatted files.	PO2 (3) PO5 (3)	PSO1 (2) PSO2 (3) PSO3 (2)
CO5	Develop problem-solving applications using Python modules and packages such as NumPy, SciPy, Pandas, and Scikit-learn.	PO2 (3) PO3 (3) PO5 (3) PO11 (2)	PSO1 (3) PSO2 (3) PSO3 (3)

(1) = Low; (2) = Medium; (3) = High

26ENC02	Communicative English Laboratory	L	T	P	C
		0	0	4	2

Course Objectives:

- To make students proficient and confident communicators in English across a variety of contexts.
- To enable learners to comprehend both spoken English in diverse settings.
- To develop students' ability in the nuances Reading English.
- To enhance the ability of different formal and technical writings.
- To prepare learners to tackle situations and seek employment with assurance in the modern globalized world.

List of Suggested Activities

LISTENING SKILL

a) Listening Comprehension
b) Listening Native Speakers and Repeat
c) Listening to Pod casts
d) Experiencing Listening Technical Reports
e) Listening Barriers

SPEAKING SKILL

a) Phonetics
b) Pronunciation
c) Accent
d) Intonation
e) Stress
f) Pause
g) Nuances

READING SKILL

a) General and Technical Comprehension
b) Experiencing Intensive reading,
c) Extensive reading
d) Skimming and Scanning
e) Practice on Terminologies
f) Synonyms and Antonyms from technical subjects

WRITING SKILL

a) Common Errors
b) Paragraphs and Essays
c) Writing Technical Reports
d) Business Letters, Emails, Notices
e) Agenda and Minutes of Meeting

PERSONALITY DEVELOPMENT

a) SWOT Analysis
b) Digital Presentation
c) Role Play
d) Dialogue and Conversation
e) TED Talks – Extempore

TOTAL : 60 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Observation and Record (20%), Practical (30%), Internal Examinations (50%)

Text Books:

1. Dutt, Kiranmai, et al. A Course in Communication Skills. Cambridge University Press, 2008.
2. Green, David. Contemporary English Grammar: Structures & Composition. Trinity Press, 2018.

References:

1. Narayanaswami, V. R. Strengthen Your Writing. Orient Blackswan, 2009.
2. Nicholls, Anne. Mastering Public Speaking. Jaico Publication, 1999.
3. Raman, Meenakshi. Principles and Practice in Technical Communication. Oxford University Thomson, 3rd Edition, 2022
4. A.J. and A.V. Martinet. A Practical English Grammar. Oxford University Press.
5. Murphy, Raymond. Essential English Grammar. 2nd Edition, Cambridge University Press, 2022.

E-resources:
1. https://www.shortform.com/summaries 2. https://www.skillsyouneed.com/rhubarb.html 3. Sway am-NPTEL Business English Communication Portal

CO	CO Description	PO	PSO
CO1	Demonstrate effective interpersonal and intrapersonal communication skills in all the contexts.	PO7 (2) PO8 (3) PO9 (3)	PSO3(3)
CO2	Apply appropriate listening and speaking strategies to comprehend technical information.	PO8 (2) PO9 (3) PO10 (2) PO11 (2)	PSO2(2) PSO3(2)
CO3	Employ reading strategies to comprehend and interpret general and technical texts and acquire relevant technical vocabulary.	PO2 (2) PO9 (3) PO11 (2)	PSO2(2) PSO3(2)
CO4	Produce clear and accurate written communication to use in appropriate grammar and professional conventions.	PO2 (1) PO8 (2) PO9 (3)	PSO2(2) PSO3(3)
CO5	Develop personality and professional competencies for career development.	PO3 (1) PO7 (3) PO8 (3)	PSO2(2) PSO3(3)

(1) = Low; (2) = Medium; (3) = High

SEMESTER – III

26MAC04	Probability and Random Processes	L	T	P	C
		3	1	0	4

Course Objective:

To provide a rigorous mathematical foundation in statistical analysis and probability theory required for industrial quality control, semiconductor manufacturing, signal processing, and modern communication systems. The course emphasizes "small sampling theory" and stochastic processes essential for electronics R&D.

Unit I	Descriptive And Bivariate Statistics	12

Univariate Measures: Mean, Median, Mode, Variance, and Standard Deviation, Relative Variation: Coefficient of Variation (CV) for comparing component stability., Bivariate Statistics: Covariance and the Correlation Coefficient (r), Linear Regression: Method of Least Squares for sensor calibration and trend analysis.

Suggested Activities: Visualization of statistical measures and data distributions using open-source software.

Unit II	Probability Foundations And Distributions	12

Probability Theory: Axioms, Conditional Probability, and Bayes' Theorem (Signal Detection). Random Variables:Discrete (Binomial,Poisson for shot noise) and Continuous (Uniform, Exponential). The Normal Distribution: Properties of Gaussian distributions, Central Limit Theorem.

Suggested Activities: Sample data to calculate **Binomial/Poisson probabilities** and plot a **Gaussian distribution**, observing the effect of the Central Limit Theorem.

Unit III	Statistical Inference And Small Sampling	12

Sampling Distributions: Population vs. Sample; Degrees of Freedom. Small Sample Tests: Student's t-distribution (One-sample and Two-sample tests). Variance Analysis: Chi-square distribution and F-distribution for comparing production batches. Estimation: Confidence Intervals for mean and variance of device parameters.

Suggested Activities: Sampling & t-Test Activity- collect a small sample of device measurements and perform **one-sample and two-sample t-tests**, interpreting the results.

Unit IV	Hypothesis Testing And Error Metrics	12

Testing Framework: Null (H0) and Alternative (H1) Hypotheses. Decision Errors: Type I error (Alpha), Type II error (Beta), and Power of a test. P-values: Interpretation of p-values in industrial datasheets and medical electronics. Parametric & Non-Parametric: ANOVA basics and Chi-square Goodness-of-Fit tests.

Suggested Activities: Compare multiple productions groups using **ANOVA** and apply a **Chi-square goodness-of-fit test** to determine whether observed data match the expected distribution.

Unit V	Random Processes	12

Classification – Stationary process – Markov process - Poisson process - Discrete parameter Markov chain – Chapman Kolmogorov equations (Statement only) - Limiting distributions.

Suggested Activities: Simulate a **Markov chain and Poisson process** using simple real-world events, and observe the transition probabilities and event arrivals.

TOTAL : 60 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers & Keying E. Ye, "Probability & Statistics for Engineers & Scientists", 9th Edition, Pearson.
2. Athanasios Papoulis & S. Unnikrishna Pillai, "Probability, Random Variables, and Stochastic Processes", 4th Edition, McGraw-Hill.

References:

1. Roy D Yates and David J Goodman, "Probability and Stochastic Processes", 4th Edition, Wiley India, New Delhi, 2021 .
2. Douglas C Montgomery and George C Runger, "Applied Statistics and Probability for Engineers", 7th edition, Wiley India, New Delhi, 2020.
3. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes", 1st Indian Reprint, Elsevier, 2014.
4. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", 5th Edition, CRC Press, USA, 2024.
5. Stark. H and Woods J.W, "Probability and Random Processes with Applications to Signal processing", 3rd Edition, Pearson Education, Asia, 2001 .

E-Resources:

1.https://www.itl.nist.gov/div898/handbook/?utm
2. https://ocw.mit.edu/search/?q=probability+statistics&utm
3. https://nptel.ac.in/courses/111/105/111105041/?utm_source

CO	CO Description	PO	PSO
CO1	Understand the basic concepts of probability, random variables, standard probability distributions and random processes.	-	-
CO2	Apply joint distributions, correlation, regression and transformation of random variables for real-world data analysis.	PO1(3)	PSO1(1) PSO2(2)
CO3	Model and simulate random phenomena using stochastic processes and analyze their long-term behavior.	PO2(3) PO5(3)	PSO2(2) PSO3(1)
CO4	Analyze spectral properties of random signals, including autocorrelation, cross-correlation and spectral density functions.	PO2(3)	PSO2(2)
CO5	Examine linear time-invariant systems with random inputs using transfer function analysis and stochastic system modeling.	PO2(3) PO5(3)	PSO2(2)

(1) = Low; (2) = Medium; (3) = High

26BM301	Electronic Devices and Circuits	L	T	P	C
		3	0	0	3

Course Objectives:

This course aims to provide a solid foundation in the principles, characteristics, and applications of semiconductor devices such as diodes, BJTs, and FETs and design basic electronic circuits for rectification, amplification, and switching purposes, special and power semiconductor devices used in modern electronic and optoelectronic systems.

Unit I	Semiconductor Diodes	9

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes, Zener diodes, tunnel diode, LDR, p-i-n diode.

Suggested Activities: Plot and analyse the forward and reverse V–I characteristics of a PN junction diode and Zener diode

Unit II	Diode Applications	9

Load Line Analysis, Series Diode Configurations with DC Inputs, Parallel and Series-Parallel Configurations, Half-Wave Rectification. Full-Wave Rectification. Clippers. Clampers. Zener Diodes. Voltage Multiplier Circuits.

Suggested Activities: Design and simulate clippers, clampers, Zener voltage regulators and voltage multiplier circuits**,** and analyse their applications in practical electronic power-supply and signal-conditioning circuits.

Unit III	Bipolar Junction Transistors	9

NPN and PNP Transistor Operation. Common-Base Configuration. Common-Emitter Configuration. Limits of Operation. DC Biasing-BJTs. Operating Point. Fixed-Bias Circuit. Emitter-Stabilized Bias Circuit. Voltage-Divider Bias. DC Bias with Voltage Feedback. BJT small signal model, high frequency model– Analysis of CE amplifier - Gain and frequency response.

Suggested Activities: Design and analyse BJT fixed-bias, emitter-stabilized and voltage-divider bias circuits to determine the operating point (Q-point), and study the effect of biasing on transistor stability.

Unit IV	Field Effect Transistors	9

MOSFETs – Drain and Transfer characteristics, -Current equations -Pinch off voltage and its significance-Threshold voltage -Channel length modulation, D MOSFET, E-MOSFET- Characteristics.

Suggested Activities: Plot and analyse the drain and transfer characteristics of D-MOSFET and E-MOSFET using simulation software, and determine the threshold voltage and pinch-off voltage.

Unit V	Feedback Amplifiers and Oscillators	9

Basic concepts of feedback -negative feedback, series, Shunt feedback –Positive feedback – Condition for oscillations – RC phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators, Power amplifiers-Class A and Class B.

Suggested Activities: Design and simulate RC phase-shift, Wien bridge, Hartley, Colpitts and crystal oscillators, and verify the condition for sustained oscillations by observing the output waveforms.

TOTAL : 45 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%)

Text Books:

1. Boylestad, R. L., & Nashelsky, L. (2014). Electronic devices and circuit theory, 11th Edition, Pearson Prentice Hall.
2. Bhattacharya, P., & Sharma, S. (2014). Solid state electronic devices, 2nd Edition, Oxford University Press.

References:

1. Sedha, R. S. (2010). A textbook of electronic devices and circuits, 1st Edition, S. Chand Publications.
2. Bell, D. A. (2008). Electronic devices and circuits, 5th Edition, Oxford University Press.
3. Robert L. Boylestad & Louis Nashelsky Electronic Devices and Circuit Theory, 11th Edition, Pearson Education.

4. Millman & Halkias Integrated Electronics: Analog and Digital Circuits and Systems, 2nd Edition, McGraw-Hill Education.
5. Ben G. Streetman & Sanjay Banerjee Solid State Electronic Devices, 7th Edition, Pearson.

E-resources:

1.https://www.vlab.co.in/broad-area-electronics-and-communications
2.https://be-iitkgp.vlabs.ac.in/
3.http://vlabs.iitkgp.ac.in/be/`

CO	Description of CO	PO	PSO
CO1	Explain the principles, characteristics, and operation of semiconductor diodes and their applications.	-	-
CO2	Analyze and design diode circuits for rectification, clipping, clamping, and voltage regulation.	PO2(3) PO3(3)	PSO1(3) PSO2(3)
CO3	Design and analyze the operation and biasing of BJTs and FETs, and analyze their small-signal models.	PO1(3) PO2(3) PO3(2)	PSO1(3) PSO2(3)
CO4	Design and analyze amplifier circuits, feedback amplifiers, and oscillators using BJTs and FETs.	PO1(3) PO2(3) PO5(2)	PSO2(3) PSO2(3)
CO5	Design and simulate any analog circuits using EDA tools.	PO1(3) PO2(3) PO3(3)	PSO1(3) PSO2(3)

(1) = Low; (2) = Medium; (3) = High

26BM302	Biomedical Signals and Systems	L	T	P	C
		3	1	0	4

Course Objectives:

- To introduce the origin, characteristics, and acquisition of physiological signals.
- To impart signal processing and filtering techniques for biomedical noise and artifact removal.
- To develop skills in feature extraction, pattern recognition, and modeling of physiological systems for diagnostic applications.

Unit I	Introduction to Biomedical Signals	12

Origin and characteristics of physiological signals – ECG, EEG, EMG, PPG, EOG. Biomedical signal acquisition system: sensors, transducers, bio-amplifiers. Electrode–tissue interface, isolation and safety. Noise and artifacts: powerline interference, motion artifact, baseline wander. Sampling theorem, quantization, and aliasing in biosignal acquisition.
Suggested Activities: MATLAB/Python signal-processing labs, ECG/EMG acquisition using Arduino or biomedical kits.

Unit II	Signal Processing Fundamentals	12

Review of continuous- and discrete-time signals and LTI systems, convolution and impulse response. Fourier series, Fourier transform, and the Discrete Fourier Transform (DFT/FFT). Power spectral density estimation: Periodogram and averaged periodogram methods for biomedical signals.
Suggested Activities: Generate continuous-time and discrete-time signals using MATLAB/Python, and perform convolution to obtain the output of an LTI system for a given impulse response.

Unit III	Filtering of Biomedical Signals	12

FIR and IIR filter design for artifact and noise removal, notch filtering for powerline interference. Adaptive filtering: LMS and RLS algorithms for noise cancellation. Wavelet transform for non-stationary signal analysis of ECG and EEG.
Suggested Activities: Design and compare FIR, IIR and notch filters using MATLAB/Python for removal of noise, artifacts and powerline interference from biomedical signals.

Unit IV	Biomedical Signal Analysis & Feature Extraction	12

Time-domain and frequency-domain feature extraction, envelope extraction and RMS analysis. QRS detection using the Pan–Tompkins algorithm and heart rate variability analysis. EEG rhythm analysis: alpha, beta, delta, and theta bands. Basic pattern classification (SVM/ML) for arrhythmia and seizure detection.
Suggested Activities: Implement the Pan–Tompkins algorithm for QRS detection and heart rate variability analysis, followed by basic SVM/ML-based classification for arrhythmia or seizure detection.

Unit V	System Modeling & Biomedical Imaging	12

Compartmental models in pharmacokinetics. Cardiovascular and respiratory system modeling. Physiological control systems, e.g. glucose–insulin regulation. Basics of imaging modalities – X-ray, CT, MRI, ultrasound – and the image as a 2D signal.
Suggested Activities: Develop mathematical models of the cardiovascular, respiratory and glucose–insulin systems using MATLAB/Python, and simulate their response to changes in physiological parameters.

TOTAL : 60 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%)

Textbooks:

1. Rangaraj M. Rangayyan, Biomedical Signal Analysis: A Case-Study Approach, 2nd Edition, Wiley-IEEE Press.
2. Willis J. Tompkins, Biomedical Digital Signal Processing, 2nd Edition, Prentice Hall of India.

References:

1. John L. Semmlow, Biosignal and Biomedical Image Processing: MATLAB-Based Applications, Marcel Dekker.
2. Eugene N. Bruce, Biomedical Signal Processing and Signal Modeling, Wiley.
3. D. C. Reddy, Biomedical Signal Processing: Principles and Techniques, McGraw Hill.
4. Metin Akay, Biomedical Signal Processing, Academic Press.
5. Arnon Cohen, Biomedical Signal Processing (Vol. I & II), CRC Press.

E-Resources:

1. https://nptel.ac.in/courses/108105101
2. https://nptel.ac.in/courses/102106669
3. https://nptel.ac.in/courses/102105090

CO	CO Description	PO	PSO
CO1	Explain the origin and characteristics of major biomedical signals and their acquisition.	---	---
CO2	Apply time- and frequency-domain techniques to analyze biomedical signals.	PO1 (2) PO2 (3)	PSO1 (2) PSO2 (3)
CO3	Design digital and adaptive filters for artifact and noise removal in biosignals.	PO2 (3) PO3 (2)	PSO1 (2) PSO2 (3)
CO4	Extract meaningful features and apply basic classification techniques for diagnostic support.	PO1 (3) PO2 (3) PO4 (2)	PSO1 (3) PSO2 (3)
CO5	Model physiological systems and relate signal processing concepts to biomedical imaging.	PO1 (3) PO2 (3) PO5 (2)	PSO1 (3) PSO2 (2)

(1) = Low; (2) = Medium; (3) = High

26BM303	Electric Circuit Analysis	L	T	P	C
		3	0	2	4

Course Objective:

To introduce the basic concepts of DC and AC circuits behavior and to study the transient and steady state response of the circuits subjected to step and sinusoidal excitations and different methods of circuit analysis using Network theorems, duality and topology.

Unit I	DC Circuit Analysis	9

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchhoff's Current Law, Kirchhoff's voltage law, the single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis & Mesh analysis using Independent and Dependent Sources. Super Mesh, Super Node.

Suggested Activities: Perform nodal, mesh, super node and super mesh analysis and compare the results with simulation.

Unit II	Network Theorem	9

Useful Circuit Analysis techniques using Independent and Dependent Sources - Linearity and superposition, Reciprocity Theorem, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duality**:** Duals, Dual circuits.

Suggested Activities: Verify Superposition, Thevenin, Norton and Maximum Power Transfer theorems using circuit simulation software.

Unit III	Sinusoidal Steady State Analysis	9

State analysis, Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

Suggested Activities: Calculate and analyse instantaneous, average, apparent and complex power, and determine the power factor for practical AC circuits.

Unit IV	Transients And Resonance in RLC Circuits	9

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit- Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

Suggested Activities: Analyse RL, RC and RLC circuits for transient response and frequency response using MATLAB/Python or circuit simulation software.

Unit V	Coupled Circuits and Topology	9

Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer.
An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.

Suggested Activities: Verify the operation of magnetically coupled circuits and transformers by measuring primary and secondary voltages and currents.

TOTAL : 45 PERIODS

List of Experiments

1. Verification of Mesh Analysis for DC Circuits.
2. Verification of Nodal Analysis for DC Circuits.
3. Verification of Thevenin, Norton & Super Position Theorems for DC Circuits.
4. Verification of Maximum Power Transfer & Reciprocity Theorems for DC Circuits
5. Verify mesh and nodal analysis for AC circuits.
6. Determination of Resonant Frequency of Series & Parallel RLC Circuits.
7. Study of DC transients in RL, RC and RLC circuits
8. Simulate the DC and AC circuits using simulation tools
9. Determine phasor relationship, real power (P), reactive power (Q), apparent power (S) and power factor in AC circuits using EDA tools

TOTAL (Lab.): 15 PERIODS
TOTAL: 60 PERIODS

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%.

Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%)

Text Books:

1. Boylestad, R. L. (2014). Introductory circuit analysis, 12th Edition, Pearson Education India.
2. Alexander, C. K., & Sadiku, M. N. O. (2022). Fundamentals of electric circuits, 7th Edition, McGraw-Hill.

References:

1. Hayt, J., Kemmerly, S., & Durbin, S. (2024). Engineering circuit analysis, 10th Edition, McGraw-Hill Education.
2. Boy lestad, R. L. (2014). Introductory circuit analysis, 12th Edition, Pearson Education India.
3. Alexander, C. K., & Sadiku, M. N. O. (2022). Fundamentals of electric circuits , 7th Edition, McGraw-Hill.
4. Cunningham, D. R., & Stuller, J. A. (2005). Basic circuit analysis. Jaico Publishing House.
5. Bell, D. (2009). Fundamentals of electric circuits, 7th Edition, Oxford University Press.
   Mallay, J. O. (2011). Schaum's outlines: Basic circuit analysis, 2nd Edition, McGraw-Hill.

E-resources:

1. https://nptel.ac.in/courses/117106148
2. https://nptel.ac.in/courses/117106108
3. https://ec-amrt.vlabs.ac.in/

CO	Description of CO	PO	PSO
CO1	Explain and apply fundamental electrical laws (Ohm's Law, KCL, KVL) to analyse DC circuits.	-	-
CO2	Analyze electrical networks using nodal, mesh analysis and network theorems.	PO1(3) PO2(3) PO4(3)	PSO1(2) PSO2(3)
CO3	Evaluate steady-state behavior of AC circuits using phasors and power concepts.	PO1(3) PO2(3) PO5(3)	PSO1(3) PSO2(3)
CO4	Analyze transient response of RL, RC, and RLC circuits under different excitations.	PO1(3) PO2(3) PO4(3) PO5(3)	PSO1(3) PSO2(3)
CO5	Apply network topology concepts to analyze electrical networks using tree, loop, and generalized nodal analysis techniques.	PO1(3) PO2(3) PO5(3)	PSO1(2) PSO2(3) PSO3(2)

(1) = Low; (2) = Medium; (3) = High

26BMC01	Sensors and Measurement Systems	L	T	P	C
		3	0	2	4

Course Objectives:
Understand measurement systems and sensor characteristics. Study electrical, electronic and MEMS sensors and signal conditioning. Interface sensors with microcontrollers and IoT systems. Develop sensor-based engineering applications.

Unit I	Measurement Systems	9

Measurement fundamentals, static and dynamic characteristics, errors in measurements, calibration techniques, standards, primary and secondary standards, analog and digital instrumentation.
Suggested Activities: Study and compare the performance of analog and digital measuring instruments using real-time measurement examples.

Unit II	Electrical and Electronic Sensors	9

RTD, Thermistor, Strain Gauge, LVDT, Hall Effect sensor, current sensor, voltage sensor, pressure sensor, displacement sensor, temperature sensors and their applications.
Suggested Activities: Case study on industrial applications of temperature, pressure and displacement sensors.

Unit III	Optical and MEMS sensors	9

Photodiode, Phototransistor, IR sensor, Ultrasonic sensor, MEMS accelerometer, gyroscope, humidity sensor, gas sensor, proximity sensors and engineering applications.
Suggested Activities: Develop a sensor-based object detection or environmental monitoring prototype using optical/MEMS sensors.

Unit IV	Signal Conditioning and Data Acquisition	9

Wheatstone bridge, instrumentation amplifier, isolation amplifier, active filters, ADC, DAC, CRO, DSO, Arduino/ESP32 interfacing, data acquisition systems.
Suggested Activities: Design and simulate a signal conditioning circuit using simulation software.

Unit V	Smart Sensors and IOT Applications	9

Digital sensors, I²C and SPI communication, wireless sensor networks, IoT sensor nodes, industrial sensors, automotive sensors, AI/ML applications in smart sensing.
Suggested Activities: Develop a mini IoT-based smart sensor application using ESP32/Arduino and cloud platform.

TOTAL : 45 PERIODS

List of Experiments
1. Determine static characteristics of a measurement system.
2. Calibration of voltmeter and ammeter using standard instruments.
3. Error analysis and uncertainty calculation for electrical measurements
4. Characteristics of RTD and Thermistor.
5. Displacement measurement using LVDT.
6, Characteristics of Strain Gauge using Wheatstone Bridge.
7. Characteristics of Photodiode and Phototransistor.
8. Distance measurement using Ultrasonic Sensor.
9. Interfacing MEMS accelerometer with Arduino/ESP32.
10. Wheatstone Bridge for resistance measurement.
11. Design and testing of active low-pass filter.
12.ADC interfacing with Arduino/ESP32 and sensor data acquisition
13. Interfacing digital temperature/humidity sensor using I²C.
14. IoT-based sensor monitoring using ESP32 and Wi-Fi.
15. Mini project: Smart sensor-based monitoring system.

TOTAL (Lab.): 15 PERIODS
TOTAL: 60 PERIODS

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%.

Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%)

Text Books:

1. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Co., 19th Reprint, New Delhi.
2. D. Patranabis, Sensors and Transducers, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi.

References:

1. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Co.,19th Reprint, New Delhi.
2. E.O. Doebelin and D.N. Manik, Measurement Systems: Application and Design, 6th Edition, McGraw-Hill Education.
3. H.S. Kalsi, Electronic Instrumentation, 4th Edition, McGraw-Hill Education.
4. D. Patranabis, Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw-Hill Publishing Company.
5. J.P. Bentley, Principles of Measurement Systems, 4th Edition, Pearson Education.

E-resources:

1. https://www.ni.com/
2. https://www.nist.gov/
3. https://docs.espressif.com/

CO	CO Description	PO	PSO
CO1	Explain measurement systems, characteristics, errors, calibration, standards, and instrumentation.	PO1(3) PO2(2)	PSO1(3) PSO2(2)
CO2	Analyze electrical and electronic sensors and their applications.	PO1(3) PO2(3) PO5(3)	PSO1(3) PSO2(3) PSO3(2)
CO3	Explain optical and MEMS sensors and their engineering applications.	PO1(3) PO2(3) PO5(3)	PSO1(3) PSO2(3) PSO3(2)
CO4	Design signal conditioning and data acquisition systems using suitable electronic circuits and tools.	PO1(3) PO2(3) PO3(3) PO5(3)	PSO1(3) PSO2(3) PSO3(2)
CO5	Develop smart sensor and IoT applications using communication protocols and embedded platforms.	PO1(3) PO2(3) PO3(3) PO5(3)	PSO1(3) PSO2(3) PSO3(3)

(1) = Low; (2) = Medium; (3) = High

26BM304	Healthcare Data Analytics	L	T	P	C
		3	0	2	4

Course Objective:
To comprehend the fundamental of mathematical and statistical theory in the application of Healthcare, Apply the regression and correlation analysis on the healthcare data an Understand the Meta analysis and variance analysis, Interpret the results of the Investigational methods.

Unit I	Introduction	9

Electronic Health record- Components, Coding systems- International classification of diseases (ICD), LOINC, DICOM, Introduction to probability, likelihood & odds, distribution variability.
Suggested Activities: Solve simple healthcare probability problems involving likelihood, odds and distribution variability using sample clinical data.

Unit II	Statistical Parameters	9

p-values, computation, level chi square test and distribution and hypothesis testing - single population proportion, difference between two population proportions, single population variance, tests of homogeneity. Testing of statistical parameters using appropriate software R / Python.
Suggested Activities: Perform chi-square tests and hypothesis testing for population proportions, variances and homogeneity using R/Python, and interpret p-values.

Unit III	Regression and Correlation Analysis	9

Regression model, evaluating the regression equation, correlation model, correlation coefficient.
Suggested Activities: Develop regression and correlation models using R/Python, calculate the regression equation and correlation coefficient, and evaluate the model.

Unit IV	Analysis Of Variance	9

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.
Suggested Activities: Design sample experiments using CRD, RCBD, repeated measures and factorial designs, and compare their applications.

Unit V	Case Studies	9

Epidemical reading and interpreting of epidemical studies, application in community health, Case study on Medical Imaging like MRI, CT. Case study on respiratory data, Case study on ECG data. Predictive models to detect onset of disease.
Suggested Activities: Analyse epidemiological studies and medical datasets such as MRI, CT, respiratory and ECG data to interpret disease patterns and community health applications.

TOTAL : 45 PERIODS

List of Experiments
1, Finding the statistical distribution using appropriate software tool like R/ Python.
2. Perform basic data exploration and visualization of a healthcare dataset
3. Analysis of data from wearables devices.
4. Testing the variance using appropriate software tool like R / Python

TOTAL (Lab.): 15 PERIODS
TOTAL: 60 PERIODS

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%.

Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%)

Text Books:

1. Rosner, Bernard, Fundamentals of Biostatistics, 8th Edition. Cengage Learning, Boston, 2016. ISBN: 978-1-305-26892-0.
2. Jiang, Jingmei, Applied Medical Statistics,1st Edition. Wiley, 2022. Print ISBN: 978-1-119-71670-9.

References:

1. Daniel, W. W. (2018). Biostatistics: A foundation for analysis in the health sciences, 11th Edition, John Wiley & Sons.
2. Armitage, P., Berry, G., & Matthews, J. N. S. (2001). Statistical methods in medical research, 4th Edition,Wiley-Blackwell.
3. Pagano, M., & Gauvreau, K. (2022). Principles of biostatistics, 3rd Edition, Chapman & Hall/CRC.
4. Forthofer, R. N., & Lee, E. (2014). Introduction to biostatistics, 1st Edition, Academic Press.

5. Dutta, A. K. (2006). Basic biostatistics and its applications, 1st Edition, New Central Book Agency.

E-Resources:

1.Chandan K. Reddy, Charu C. Aggarwal, "Healthcare Data Analytics," Chapman & Hall, 2023
2.https://www.coursera.org/learn/healthcare-analytics-essentials,"Healthcare Analytics Essentials," Prof Martin Kohn, Northeastern University.
3.Health Care Data Analytics by Digital Health and Informatics, https://www.youtube.com/playlist?list=PLtkf1CzQAYcE6Ob6Yv6PLFQFIhvR7n Wl8

CO	CO Description	PO	PSO
CO1	Explain fundamental concepts of probability, statistical parameters, and coding systems in healthcare data (ICD, LOINC, DICOM).	-	-
CO2	Analyze healthcare datasets using statistical tests, p-values, chi-square tests, and hypothesis testing with R/Python.	PO1(3) PO2(3) PO4(3)	PSO2(3) PSO3(2)
CO3	Apply regression and correlation analysis to healthcare data for predictive modeling and interpretation.	PO1(3) PO2(3) PO4(3)	PSO2(3) PSO3(3)
CO4	Conduct meta-analysis, ANOVA, and interpret experimental and clinical study results for informed decision-making.	PO1(3) PO2(3) PO3(3) PO4(3)	PSO1(3) PSO2(3) PSO3(3)
CO5	Implement data analytics projects on real-world healthcare datasets using R/Python to generate actionable insights.	PO1(3) PO2(3) PO3(3) PO4(3)	PSO1(3) PSO2(3) PSO3(3)

(1) = Low; (2) = Medium; (3) = High

26BM305	Devices and Circuits Laboratory	L	T	P	C
		0	0	4	2

Course Objective:
To understand and analyse the fundamental characteristics and applications of semiconductor devices such as diodes, BJTs, JFETs, MOSFETs, and SCRs through hands-on experiments and simulations.

List of Experiments

1.Testing of electronic components (Resistors, Capacitors, PN Junction diode, Zener Diode, BJT, FET….) using multimeter and study of DSO.
2. Characteristics of PN Junction diode.
3. Characteristics of Zener diode.
4. Characteristics of LED
5. Clipper and Clamper circuits.
6. Simulate, investigate and compare the various biasing circuits of BJT amplifier.
7. Characteristics of a transistor connected in Common Base (CB) configuration and calculate current gain, input and output resistance.
8. Characteristics of a transistor connected in Common Emitter (CE) configuration and calculate current gain, input and output resistance.
9. Obtain the output waveforms and determine ripple factor of a Half Wave Rectifier with and without filter
10.Obtain the output waveforms and determine ripple factor of a Full Wave Rectifier with and without filter
11.Drain and Transfer characteristics of JFET

TOTAL:30 PERIODS

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Observation and Record (20%), Practical (30%), Internal Examinations (50%)

References:

1. Sedra, A. S., & Smith, K. C. (2020). Microelectronic circuts, 8th Edition, Oxford University Press.
2. Neamen, D. A. (2021). Microelectronics: Circuit analysis and design, 5th Edition, McGraw-Hill Education.
3. Razavi, B. (2016). Fundamentals of microelectronics, 2nd Edition, Wiley.
4. Bell, D. A. (2008). Electronic devices and circuits, 5th Edition, Oxford University Press.
5. Boylestad, R. L., & Nashelsky, L. (2021). Electronic devices and circuit theory, Pearson Education.

E-Resources:

1. https://nptel.ac.in/courses/108102112
2. MIT OpenCourseWare – Circuits and Electronics.
3. All About Circuits (www.allaboutcircuits.com).

CO	CO Description	PO	PSO
CO1	Define and explain the operation of diode circuits, transistor biasing, amplifiers, feedback systems, oscillators, and power amplifiers.	-	-
CO2	Apply circuit principles to design and implement rectifiers, filters, biasing circuits, amplifiers, and oscillators using simulation tools.	PO1(3)	PSO1(3) PSO3(2)
CO3	Analyze the performance of electronic circuits in terms of gain, frequency response, stability, and efficiency.	PO1(3)	PSO2(3)
CO4	Design and evaluate advanced circuit behavior, including feedback effects, distortion, and power amplifier performance under practical conditions.	PO3(3) PO4(3) PO5(3)	PSO3(3)

(1) = Low; (2) = Medium; (3) = High

26SDC01	Foundation Aptitude and Verbal ability Skills	L	T	P	C
		0	0	2	1

Course Objectives:

- To solve quantitative aptitude problems through practical exercises.
- To apply logical and analytical reasoning techniques.
- To improve grammar and vocabulary through practice-oriented activities.
- To demonstrate effective reading, listening and speaking skills.
- To demonstrate professional communication skills required for placement activities.

List of Activities:

1. Number System, Simplification, Percentage and Ratio
2. Average, Profit and Loss, Simple and Compound Interest
3. Time, Work, Speed, Distance and Data Interpretation
4. Number Series, Analogy, Coding-Decoding and Logical Patterns
5. Blood Relations, Direction Sense, Ranking, Syllogism and Data Sufficiency
6. Grammar, Sentence Correction and Error Spotting
7. Vocabulary, Synonyms, Antonyms, Idioms and Sentence Completion
8. Reading Comprehension, Para Jumbles and Listening Skills
9. Speaking Skills, Group Discussion and Presentation Skills
10. Resume Preparation, Interview Skills and Mock Placement Activities

TOTAL : 30 PERIODS

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Observation and Record (20%), Practical (30%), Internal Examinations (50%)

References:

1. R. S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishing. 2024
2. R. S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publishing. Fully Revised Video Edition 2024–25
3. Wren & Martin, High School English Grammar and Composition, S. Chand Publishing. Multicolour edition 2024
4. Arun Sharma, How to Prepare for Verbal Ability and Reading Comprehension for CAT, McGraw Hill Education. 2026

E-resources:

1. https://nptel.ac.in/courses/109104030

CO	CO Description	PO	PSO
CO1	Solve quantitative aptitude problems using appropriate numerical and arithmetic techniques.	PO1 (3) PO2 (2)	PSO2 (1)
CO2	Apply logical and analytical reasoning techniques to solve aptitude problems.	PO2 (3) PO4 (2)	PSO2 (2) PSO3 (1)
CO3	Apply grammar and vocabulary skills to solve verbal ability exercises.	PO1 (2) PO10 (3)	PSO3 (2)
CO4	Demonstrate effective reading, listening, speaking, group discussion and presentation skills.	PO8 (3) PO9 (3) PO10 (3)	PSO3 (3)
CO5	Demonstrate professional communication skills through resume preparation, interviews and mock placement activities.	PO6 (2) PO8 (3) PO9 (3)	PSO1 (1) PSO2 (2) PSO3 (3)

(1) = Low; (2) = Medium; (3) = High

SEMESTER-IV

26BM401	Bio Control Systems	L	T	P	C
		3	0	0	3

Course Objective:

- To present a clear exposition of the classical methods of control engineering and to describe physical system modeling, and basic principles of frequency and time domain design techniques.
- To teach the practical control system design with realistic system specifications and to provide knowledge of physiological control system concept and design.

Unit I	Introduction to Control Systems and Mathematical modelling	9

Block diagram of control system – Open loop and closed loop – Introduction to Physiological control systems- Illustration, Linear models of physiological systems, s – Equivalence between the elements of different types of systems, Mathematical Modeling of systems, Block diagram and signal flow graph representation of systems – reduction of block diagram and signal flow graph.

Suggested Activities: Develop regression and correlation models using R/Python, calculate the regression equation and correlation coefficient, and evaluate the model.

Unit II	Time Domain Response	9

Step and impulse responses of first order systems, step responses of second order systems – time domain specifications of first and second order systems – steady state error constants. Controllers – P, PI, PID controllers.

Suggested Activities: Develop regression and correlation models using R/Python, calculate the regression equation and correlation coefficient, and evaluate the model.

Unit III	Stability Analysis	9

Concept and definition, Poles, Zeros, Order and Type of systems, Routh- Hurwitz criteria of stability, Root locus technique – construction of root locus and study of stability.

Suggested Activities: Develop regression and correlation models using R/Python, calculate the regression equation and correlation coefficient, and evaluate the model.

Unit IV	Frequency Response Analysis	9

Specifications – Polar plots – Bode plots – Nyquist plot – Nyquist stability criterion, closed loop stability – Constant M and N circles – Nichol's chart. Stability analysis in frequency domain.

Suggested Activities: Develop regression and correlation models using R/Python, calculate the regression equation and correlation coefficient, and evaluate the model.

Unit V	Biological Control System Analysis	9

Model development of Cardiovascular system- Heart model-circulatory model, Pulmonary mechanics- Interaction of Pulmonary and Cardiovascular models, Regulation of cardiac output, steady state analysis of muscle stretch reflex action, transient response analysis of neuromuscular reflex model action, frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

Suggested Activities: Develop regression and correlation models using R/Python, calculate the regression equation and correlation coefficient, and evaluate the model.

TOTAL : 45 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. Nagarath, J., & Gopal, M. (2021). Control systems engineering. New Age International Publishers.(7th Edition)
2. Khoo, M. C. K. (2018). Physiological control systems. IEEE Press; Prentice Hall India. (2nd Edition)

References:

1. Salivahanan, S., Rengaraj, R., & Venkatakrishnan, G. R. (2017). Control systems engineering. Pearson Education India. (1st Edition)
2. Kuo, B. C. (2015). Automatic control systems. Prentice Hall of India.
3. Enderle, J., Blanchard, S., & Bronzino, J. (2005). Introduction to biomedical engineering (2nd Edition). Academic Press.
4. Ogata, K., & Yang, Y. (2002). Modern control engineering (Vol. 4). Prentice-Hall.
5. Dorf, R. C., & Bishop, R. H. (2021). Modern control systems. Pearson. (14th Edition)

E-Resources:

1.https://nptel.ac.in/courses/108/101/108101037/
2.https://nptel.ac.in/content/storage2/courses/112104158/lecture14.pdf
3.https://nptel.ac.in/content/storage2/courses/112104158/lecture16.pdf

CO	CO Description	PO	PSO
CO1	Explain the fundamental concepts of control systems, including open-loop and closed-loop systems, feedback, block diagrams, and physiological control system models.	-	-
CO2	Develop mathematical models of electrical, mechanical, and physiological systems and represent them using transfer functions, block diagrams, and signal flow graphs.	PO1 (3) PO2 (3) PO3(3)	PSO1(3) PSO2(3)
CO3	Analyze the time-domain response of control systems using standard test signals and evaluate system performance and stability.	PO1(3) PO2(3) PO4(3)	PSO1(3) PSO2(3)
CO4	Analyze the frequency-domain response and stability of control systems using frequency response techniques, Bode plots, Nyquist plots, and stability criteria.	PO1(3) PO2(3) PO4(3) PO5(3)	PSO1(3) PSO2(3)
CO5	Apply MATLAB and CVSIM simulation tools to design, simulate, and analyze physiological control models such as lung dynamics and cardiac output regulation.	PO3(3) PO5(3) PO9(2)	PSO1(3) PSO2(3)

(1) = Low; (2) = Medium; (3) = High

26BM402	Instrumentation of Medical Applications	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the fundamental principles of medical instrumentation and biomedical measurement systems.
- To understand the origin, characteristics and acquisition of physiological and bio-potential signals.
- To study sensors, electrodes, transducers and signal-conditioning techniques used in medical applications.
- To understand the measurement of important physiological and biochemical parameters.
- To familiarize students with diagnostic, imaging, life-supporting and therapeutic medical instruments.

Unit I	Fundamentals Of Medical Instrumentation	9

Introduction to medical instrumentation – terminology of medical instrumentation – generalized medical instrumentation system – classification of biomedical instruments – medical measurement constraints – static and dynamic characteristics – sources of measurement errors – interfering and modifying inputs – compensation techniques – transducers and sensors for biomedical applications – selection criteria for biomedical transducers – electrical safety in medical environment.

Suggested Activities: Case study on the design and working of a modern medical instrument.

Unit II	Biopotentials And Biomedical Signal Acquisition	9

Origin of bio-potentials – electrical activity of excitable cells – characteristics of biomedical signals – frequency and amplitude ranges – bio-potential electrodes – electrode-electrolyte interface – electrode-skin interface – polarization effects – polarizable and non-polarizable electrodes – surface electrodes – needle electrodes – microelectrodes – electrode configurations – bio-amplifiers – instrumentation amplifier – isolation amplifier – filtering and noise reduction – artifacts in biomedical signal acquisition.

Suggested Activities: Demonstration and analysis of ECG, EEG and EMG signals using biomedical signal acquisition software.

Unit III	Physiological Parameter Measurement	9

Measurement of heart rate – blood pressure measurement – direct and indirect methods – cardiac output – blood flow measurement – heart sounds – phonocardiography – respiratory system measurements – spirometry – pulmonary function tests – plethysmography – photoplethysmography – galvanic skin response – body temperature measurement – blood gas analysis – measurement of blood pH – pO_2 and pCO_2 – pulse oximetry.

Suggested Activities: Laboratory/clinical demonstration of blood pressure, pulse oximetry, ECG and respiratory measurements.

Unit IV	Medical Imaging And Diagnostic Instrumentation	9

Principles of medical imaging – X-ray imaging – X-ray machine components – digital radiography – computed tomography – basic principles of CT – magnetic resonance imaging – principles of MRI – ultrasound imaging – ultrasonic transducers – Doppler ultrasound – nuclear medicine imaging – SPECT – PET – endoscopy – thermal imaging – image acquisition and basic image quality parameters.

Suggested Activities: Seminar/presentation on emerging medical imaging technologies and their clinical applications.

Unit V	Therapeutic, Life-Supporting And Intelligent Medical Devices	9

Cardiac pacemakers – defibrillators – ventilators – nerve and muscle stimulators – diathermy – dialysis machines – heart-lung machine – lithotripsy – infusion and drug delivery systems – infant incubators – audiometers – therapeutic and prosthetic devices – surgical instruments – robotic surgical systems – wearable medical devices – remote patient monitoring – IoT-enabled medical instrumentation – introduction to AI-assisted medical instruments.

Suggested Activities: Case study on the application of IoT, AI and wearable technologies in patient monitoring.

TOTAL : 45 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1. John G. Webster, Medical Instrumentation: Application and Design, 4th Edition, Wiley, 2015.
2. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, 4th Edition Pearson Education.

References:

1. L. A. Geddes and L. E. Baker, Principles of Applied Biomedical Instrumentation, 3rd Edition, Wiley.
2. Antony Y. K. Chan, Biomedical Device Technology: Principles and Design, 3rd Edition, Charles C. Thomas Publisher.
3. Richard Aston, Principles of Biomedical Instrumentation and Measurement, Merrill.
4. Joseph D. Bronzino, The Biomedical Engineering Handbook, 4th Edition, CRC Press.
5. R. S. Khandpur, Handbook of Biomedical Instrumentation, 3rd Edition, McGraw Hill.

E-Resources:

1. NCBI – National Center for Biotechnology Information – biomedical and medical research resources.
2. MedlinePlus – National Library of Medicine – medical and health information.
3. FDA – Medical Devices – medical-device safety and regulatory information.

CO	CO Description	PO	PSO
CO1	Explain fundamental principles and safety requirements of medical instrumentation	PO1(3) PO2(3) PO3(2)	PSO1(3) PSO2(2)
CO2	Analyze biomedical signals, sensors, electrodes and bio-amplifiers	PO1(3) PO2(3) PO3(3)	PSO1(3) PSO2(3)
CO3	Apply instrumentation techniques for physiological parameter measurement	PO1(3) PO2(3) PO3(3)	PSO1(3) PSO2(3)
CO4	Explain diagnostic and medical imaging instrumentation	PO1(3) PO2(3) PO3(3)	PSO1(3) PSO2(3)
CO5	Analyze therapeutic, life-supporting and intelligent medical devices	PO1(3) PO2(3) PO3(3)	PSO1(3) PSO2(3)

(1) = Low; (2) = Medium; (3) = High

26BM403	Human Medical Ethics	L	T	P	C
		3	0	0	3

Course objectives:

- Understand the basic concepts, principles, and values of medical ethics.
- Recognize the importance of respect for human dignity, autonomy, beneficence, non-maleficence, and justice in healthcare.
- Develop effective and ethical doctor–patient/healthcare professional–patient relationships.
- Understand the principles of informed consent, confidentiality, privacy, and patient rights.
- Identify and analyze ethical dilemmas that arise in clinical practice.

Unit I	Introduction and Principles of Medical Ethics	9

Meaning and scope of ethics – Ethics , morality and law – importance of ethics in healthcare – professionalism and duties of healthcare professionals – Autonomy – Beneficence – non maleficence – – Respect for human dignity.

Suggested Activities: valuate a healthcare situation and identify the ethical principles involved before proposing an appropriate course of action.

Unit II	Doctor-patient relationship and Informed consent	9

Trust and communication - confidentiality and privacy - shared decision-making - Professional boundaries - types of consent - capacity and competence - consent in children - Consent in unconscious/emergency patients - refusal of treatment.

Suggested Activities: Analyze healthcare scenarios involving confidentiality, privacy, informed consent, and refusal of treatment.

Unit III	Research , Reproductive and Genetic Ethics	9

Ethics of human subject research – Clinical trials – Institutional Ethics committees – Vulnerable population – Research consent – plagiarism , fabrication and falsification – IVF and surrogacy – prenatal diagnosis – Genetic testing and gene editing.

Suggested Activities: Conduct a mock research ethics committee meeting to review a proposed clinical study and research consent process.

Unit IV	Public Health Ethics , Medical Law and Professional Conduct	9

Individual rights vs. public interest – vaccination - Infectious-disease control – Health equity - Medical negligence – malpractice - professional misconduct - legal responsibilities of doctors - Ethical codes and regulatory bodies.

Suggested Activities: Analyze a hypothetical medical negligence case and identify the duty of care, breach of duty, harm, causation, and professional responsibility involved.

Unit V	Contemporary Ethical Issues , Case Studies and Ethical Decision-Making	9

Artificial intelligence in healthcare – telemedicine - commercialization of healthcare - medical tourism - Identifying ethical dilemmas - applying ethical principles - balancing competing values - ethical decision - discussion of real-world cases.

Suggested Activities: Assign contemporary cases involving AI, telemedicine, medical tourism, or commercialization of healthcare. Students present the ethical issues, competing values, and possible solutions.

TOTAL: 45 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text books:

1.Principles of Biomedical Ethics - Tom L. Beauchamp & James F. Childress, 8th Edition, Oxford University Press, 2019.

2.World Health Organization (WHO) Standards and Operational Guidance for Ethics Review of Health-Related Research with Human Participants WHO2011

References:

1. Legal and Ethical Issues for Health Professions — Elsevier Inc., 5th Edition, Elsevier, 2023.
2. Law and Medical Ethics — J. Kenyon Mason & Alexander McCall Smith, 5th Edition, Butterworths Law, 1998
3. Bioethics and the Law — Janet L. Dolgin, Ashley R. Hurst & Lois L. Shepherd, 5th Edition, Aspen Publishing, 2024.
4. Indian Council of Medical Research (ICMR) National Ethical Guidelines for Biomedical and Health Research Involving Human Participants, 2017 Edition.
5. Dan W. Brock Life and Death: Philosophical Essays in Biomedical Ethics Cambridge University Press

E-Resources:

1 https://www.wma.net/what-we-do/medical-ethics/
2. https://www.ncbi.nlm.nih.gov/
3. https://www.gmc-uk.org/ethical-guidance

CO	CO Description	PO	PSO
CO1	Explain the fundamental concepts, principles, scope, and importance of medical ethics, morality, law, and professionalism in healthcare, with emphasis on autonomy, beneficence, non-maleficence, and human dignity.	PO1(2) PO2(2) PO3(1) PO4(2)	PSO1(2) PSO2(3)
CO2	Demonstrate understanding of the doctor–patient relationship, effective communication, confidentiality, privacy, professional boundaries, and informed consent, including consent in special and emergency situations.	PO1(2) PO2(2) PO3(1) PO4(2)	PSO1(2) PSO2(3) PSO3(3)
CO3	Analyze ethical issues related to human-subject research, clinical trials, vulnerable populations, research misconduct, reproductive technologies, prenatal diagnosis, genetic testing, and gene editing.	PO1(2) PO2(3) PO3(2) PO4(3)	PSO2(3) PSO3(3)
CO4	Examine ethical and legal issues in public health, vaccination, infectious-disease control, health equity, medical negligence, malpractice, professional misconduct, and regulatory responsibilities.	PO1(2) PO2(3) PO3(2) PO4(2)	PSO2(3) PSO3(3)
CO5	Apply ethical principles and decision-making approaches to contemporary healthcare issues such as artificial intelligence, telemedicine, commercialization, medical tourism, and real-world clinical case studies.	PO1(3) PO2(3) PO3(3) PO4(3)	PSO2(3) PSO3(3)

(1) = Low; (2) = Medium; (3) = High

26BM404	Analog and Digital Integrated Circuits	L	T	P	C
		3	0	0	3

Course Objective:

- The student should be made to study the circuit configuration and implement practical applications of linear integrated circuits and understand the concept of application of ADC and DAC in real time systems and Phase Locked Loop with applications.
- Study of basic gates and combinational logic circuits and design of various combinational digital circuits using logic gates bring out the analysis and design procedures for synchronous and asynchronous sequential circuits.

Unit I	Operational Amplifier	9

Ideal characteristics, Performance parameters, Linear and nonlinear Circuits and their analysis - voltage follower, Inverting amplifier, Non-inverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator, Multivibrator and Schmitt trigger, Triangular wave generator.

Suggested Activities: Design and simulate voltage follower, inverting amplifier, and non-inverting amplifier circuits.

Unit II	Digital to analog converters ,Analog to Digital Converters and PLL	9

Analog switches, High speed sample and hold circuit and IC's, Types of D/A converter - Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution,A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, PLL- Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator.

Suggested Activities: Implement or simulate weighted-resistor and R-2R ladder DACs. Apply different digital input combinations and observe the corresponding analog output. Compare their accuracy, resolution, and circuit complexity.

Unit III	Basic Gates	9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, 84-2-1, 2421, Excess 3, Biquinary, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Min terms and Maxterms, Karnaugh map and Tabulation methods. Logic families - TTL, MOS, CMOS.

Suggested Activities: Construct AND, OR, NOT, NAND, NOR, XOR, and XNOR circuits using ICs or a digital simulator.

Unit IV	Combinational Logic Circuits	9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders,Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux / Demux, ROM, PLA and PAL.

Suggested Activities: Design Binary-to-Gray and Gray-to-Binary converters.

Unit V	Sequential Logic Circuits	9

Flip flops – SR, JK, T, D, Master / Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – state minimization, state assignment, circuit implementation. Counters, RippleCounters, Ring Counters. Types of Registers, Serial In - Serial Out, Serial In - Parallel out, ParallelIn -Serial Out, Parallel In - Parallel Out, Universal Shift Register.

Suggested Activities: Investigate how edge triggering or master-slave operation eliminates race-around.

TOTAL : 45 PERIODS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Quiz (10%), Competitive Examinations (20%), Flipped Class (10%), Internal Examinations (40%).

Text Books:

1.Mano, M. M., & Ciletti, M. D. (2018). Digital design (6th ed.). Pearson.

2.Roth, C. H., Kinney, L. L., & H., R. G. (2024). Fundamentals of logic design. Cengage India Private Limited. (4th Edition)

References:

1.Gayakwad, R. A. (2015). Op-amp and linear ICs (4th Edition). Prentice Hall.

2.Taub, H., & Schilling, D. L. (2017). Digital integrated electronics. McGraw Hill.

3.Coughlin, R. F., & Driscoll, F. F. (2016). Operational amplifiers and linear integrated circuits. Prentice Hall.
4.Floyd, T. L. (2021). Digital fundamentals (4th Edition). Pearson Education.
5.Wakerly, J. F. (2018). Digital design: Principles and practices (5th Edition). Pearson Education

E-Resources:

1. https://nptel.ac.in/courses/117103064
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee157
3. https://ae-iitr.vlabs.ac.in/

CO	CO Description	PO	PSO
CO1	Explain the characteristics, performance parameters, and applications of operational amplifiers in linear and nonlinear circuits.	-	-
CO2	Design and analyze circuits using ADCs, DACs, and Phase Locked Loops (PLL) for real-time system applications.	PO2(3) PO3(3)	PSO1(3) PSO2(3)
CO3	Apply knowledge of basic gates, Boolean algebra, number systems, and logic families to design combinational and sequential circuits including flip-flops, counters, and registers.	PO2(3) PO3(3) PO4(2)	PSO1(3) PSO2(3)
CO4	Develop practical applications through flipped classroom activities and mini-projects on operational amplifiers, ADCs, and DACs.	PO3(3) PO5(3) PO9(2)	PSO1(3) PSO2(3)
CO5	Analyze and design sequential logic circuits using flip-flops, counters, registers and state-machine concepts for digital system applications.	PO2(3) PO3(3) PO4(3) PO5(2)	PSO1(3) PSO2(3) PSO3(3)

(1) = Low; (2) = Medium; (3) = High

26BM405	Biomedical Digital Signal Processing	L	T	P	C
		3	0	2	4

Course Objectives:

- To learn about the basics of Signal Processing.
- To understand about different types of design and its application.

Unit I	Basics of Signal Processing	9

Sampling, Aliasing, FFT – Decimation in the radix- 2 algorithm, Butterfly diagram, Implementation of DIT – FFT algorithm, FFT- Decimation in Frequency radix- 2 algorithm, Characteristics, Different types of bioelectric signals, Bio impedance signals- characteristics, Bio acoustic signals- characteristics, Bio mechanical signals – characteristics.

Unit II	IIR Filter design	9

IIR Filter- introduction, Impulse invariant method, Bilinear transformation method, Magnitude response – Butterworth filter, Chebshev filter, Design of butterworth filter using bilinear transformation technique, Design of Chebyshev filter using bilinear transformation technique. Frequency warping, Pre warping effecr. Frequency transformation – digital domain..

Unit III	FIR Filter design	9

FIR filter- advantages and disadvantages, Characteristics, Frequency method sampling method, Type I and Type II, Filter design using windowing technique- Rectangular window, Harming window, Filter design using hanning window, Blackman window, Algorithm, Synchronized averaging filters.

Unit IV	Analysis of ECG	9

P-Wave detection, Estimation of R-R interval, QRS complex detection-Template subtraction method, Template correlation method, Pan Tompkins algorithm for QRS detection-block diagram, Algorithm and waveforms, Heart rate variability –Physiological origin HRV – Generation, Clinical significance, Factors influences, Time domain methods, Frequency domain, Nonlinear analysis, Pit falls.

Unit V	Advanced techniques in Bio signal Processing	9

Speech signal analysis – Cepstrum, Analysis of complex cepstrum, Homographic filtering of speech signals, Application, Spectral distortion using a warped frequency scale, LPC and MFCC co-efficient, synchronized averaging of PCG envelopes, Envelogram, Signal averaged ECG- Clinical significance, Advantages and disadvantage, Normal and Ectopic ECG, Analysis of Exercise ECG and respiration, ACF distance method.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%.

Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%).

TOTAL : 45 PERIODS

List of experiments

1. Basic Signal operations
2. DFT and FFT computations
3. Representation of bio signals
4. Design of digital Butterworth IIR filter
5. Design of digital Low pass Chebshev IIR filter.
6. FIR filter using hamming windowing techniques.
7. Analysis of ECG
8. Analysis of Heart rate variability. DAQ systems

TOTAL (Lab.): 15 PERIODS
TOTAL: 60 PERIODS

Text Books:

1. Rangaraj.M.Rangayyan, "Biomedical signal processing", Wiley-IEEE press, 2nd Edition,2015.
2. Reddy D.C, "Biomedical signal processing: Principles and Techniques", Tata McGraw-Hill, New Delhi, 2nd Edition, 2005

References:

1. Rangarayan, R. M., Biomedical Signal Analysis: A Case-Study Approach, Wiley, 2nd Edition, 2015.

2. Tompkins, W. J., Biomedical Digital Signal Processing, Prentice Hall.
3. Sörnmo, L. and Laguna, P., Bioelectrical Signal Processing in Cardiac and Neurological Applications, Academic Press, 2005.
4. Oppenheim, A. V. and Schafer, R. W., Discrete-Time Signal Processing, Pearson/Prentice Hall.
5. Proakis, J. G. and Manolakis, D. G., Digital Signal Processing: Principles, Algorithms, and Applications, Pearson/Prentice Hall.

E-Resources

1. https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/pages/study-materials/
2. https://ocw.mit.edu/courses/2-161-signal-processing-continuous-and-discrete-fall-2008/resources/fft/
3. https://ocw.mit.edu/courses/6-341-discrete-time-signal-processing-fall-2005/.

CO	CO Description	PO	PSO
CO1	Explain the fundamentals of signal processing, FFT algorithms, and characteristics of biomedical signals	PO1(3)	PSO1(3) PSO2(2)
CO2	Design IIR digital filters using Butterworth and Chebyshev approximation techniques.	PO1(3) PO2(3) PO3(3)	PSO1(3) PSO2(3)
CO3	Design FIR filters using frequency sampling and windowing techniques for biomedical applications.	PO1(3) PO2(3) PO3(3) PO5(3)	PSO1(3) PSO2(3)
CO4	Analyze ECG signals and heart rate variability using signal processing techniques.	PO1(3) PO2(3) PO4(3) PO5(3)	PSO1(3) PSO2(3)
CO5	Apply advanced signal processing techniques for analysis of speech, PCG, ECG, and respiratory signals.	PO1(3) PO2(3) PO3(3) PO4(3) PO5(3)	PSO1(3) PSO2(3)

(1) = Low; (2) = Medium; (3) = High

26CSC16	Artificial Intelligence and Machine Learning	L	T	P	C
		3	0	2	4

Course objective:
To provide foundational AI/ML knowledge covering core techniques and enable real-world application using modern tools and frameworks.

Unit I	Introduction To AI	12

Artificial Intelligence: Introduction, Applications, Problem types. Problem formulation, Intelligent Agents: Types, Architectures, and Environments, PEAS framework. Reasoning and Logic: Propositional Logic, First-order Logic, Inference techniques including Forward and Backward Chaining.
Suggested Activities: Formulate and solve AI problems such as the 8-puzzle, route-finding, or water-jug problem using suitable state-space representations..

Unit II	Search Strategies	12

Solving problems by searching, Design issues in search algorithms. Uninformed Search: BFS, DFS. Heuristic Search: Generate-and-Test, Hill Climbing, Best-First Search, A*, Alpha-Beta pruning. Advanced methods: Problem Reduction, AO* Algorithm, Constraint Satisfaction, Means-Ends Analysis.
Suggested Activities: Implement a game-playing AI using Minimax with **Alpha-Beta pruning** and evaluate its performance in games such as Tic-Tac-Toe.

Unit III	Artificial Neural Networks	12

Introduction to Neural Networks, Activation Functions, Optimization Algorithms: Gradient Descent. Architectures: Perceptrons, Adaline, Multilayer Perceptrons. Training: Backpropagation, Procedures, Network Tuning.
Suggested Activities: Develop an Adaline model and study the effect of learning rate and number of iterations on convergence.

Unit IV	Machine Learning Basics	12

Machine Learning: Basics, Applications. Comparison with Data Mining and Big Data Analytics. Supervised Learning: Naive Bayes, KNN, Decision Trees. Unsupervised Learning: k-means clustering. Introduction to Reinforcement Learning.
Suggested Activities: Perform a comparative analysis of ML algorithms based on accuracy, execution time, scalability, and suitability for different real-world applications.

Unit V	Forecasting, Advanced Learning & Ensemble Methods	12

Forecasting: Non-linear and Logistic Regression, Random Forests, Bayesian Networks, Bias-Variance Tradeoff, Tuning and Model Selection. Clustering: EM Algorithm, Hierarchical Clustering, Post-Clustering Supervised Learning. Kernel Methods: SVM, Soft Margins, Kernel Trick. Ensemble. Methods: Bagging, Boosting, Stacking, AdaBoost, Cross-Validation. Dimensionality Reduction: PCA, LDA, MDS, Feature Selection Techniques.
Suggested Activities: Implement feature selection techniques and compare model performance before and after feature selection.

TOTAL:45 PERIODS

List of Experiments:

1. Implementation of a simple intelligent agent simulation
2. Solving AI problems using BFS and DFS algorithms
3. Implementing heuristic search strategies (A*, Hill Climbing)
4. Design and train a perceptron for basic classification
5. Building a multi-layer neural network using backpropagation
6. Data preprocessing and feature selection for ML tasks
7. Apply supervised learning algorithms (Naive Bayes, Decision Tree, KNN)
8. Unsupervised learning using k-means and Apriori algorithms
9. Regression techniques and Random Forest model implementation

10. Dimensionality reduction using PCA and LDA with visualization

TOTAL (Lab.): 15 PERIODS
TOTAL: 60 PERIODS

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%.

Assessment Methodology: Assignments (10%), Quiz (10%), Competitive Examinations (10%), Flipped Class (10%), Practical (20%), Internal Examinations (40%).

Text Books:

1. Saroj Kaushik, Artificial Intelligence, 2nd Edition, Cengage Learning India, New Delhi, 2022.
2. M. N. Murty and V. S. Ananthanarayana V. S., Machine Learning: Theory and Practice, 1st Edition, Universities Press, Hyderabad, 2024.

References:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021.
2. Tom M. Mitchell, Machine Learning, 1st Edition, McGraw Hill Education, 2017.
3. Ian Goodfellow, YoshuaBengio, and Aaron Courville, Deep Learning, 1st Edition, MIT Press, 2016.
4. Pattern Recognition and Machine Learning. By Christopher M. Bishop, 1st Edition, Springer, 2006.
5. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, By AurélienGéron, O'Reilly Media, 2022.

E-Resources:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville (MIT Press).
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by AurélienGéron (O'Reilly).
3. Think Python by Allen B. Downey (Green Tea Press).

CO	CO Description	PO	PSO
CO1	Explain the fundamental concepts of Artificial Intelligence, intelligent agents, knowledge representation, logic, and inference techniques for solving engineering problems.	PO1(3) PO2(3)	-
CO2	Apply informed and uninformed search algorithms and constraint satisfaction techniques to solve AI-based problem-solving tasks.	PO2(3) PO4(3) PO5(3)	PSO2 (3)
CO3	Analyze and develop Artificial Neural Network models using learning algorithms and optimization techniques for intelligent applications.	PO2(3) PO4(3) PO5(3)	PSO1 (3) PSO2 (3)
CO4	Apply supervised, unsupervised, and reinforcement learning techniques to solve classification, prediction, and clustering problems.	PO2(3) PO4(3) PO5(3)	PSO1 (3) PSO2 (3) PSO3 (3)
CO5	Analyze advanced machine learning algorithms, ensemble learning methods, kernel methods, forecasting models, and dimensionality reduction techniques for real-world AI applications.	PO2(3) PO5(3) PO11(3)	PSO1 (3) PSO2 (3) PSO3 (3)

(1) = Low; (2) = Medium; (3) = High

26BM406	Analog and Digital Integrated Circuits Laboratory	L	T	P	C
		0	0	4	2

Course Objective:

Students design digital logic and circuits and to learn the function of different ICs and understand the applications of operation amplifier.

List of Experiments

1.Inverting, non-inverting amplifier and comparator
2.Integrator and Differentiator
3.Design and analysis of active filters using op-amp
4.Schmitt trigger using operational amplifier
5.Instrumentation amplifier using operational amplifier
6.RC and LC oscillators
7.Multivibrators using IC555 Timer
8.Study of logic gates, Half adder and Full adder
9.Encoder and BCD to segment decoders
10.Multiplexer and demultiplexer using digital ICs
11.Universal shift register using flip flops
12.Design of mod-N counter

TOTAL:30 PERIODS

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Observation and Record (20%), Practical (30%), Internal Examinations (50%)

References:

1. Ramakant A. GayakwadOp-Amps and Linear Integrated Circuits4th EditionPrentice Hall
2.David A. BellOperational Amplifiers and Linear ICs3rd EditionOxford University Press
3.D. Roy Choudhury & Shail B. JainLinear Integrated Circuits4th EditionNew Age International
4.R. P. JainModern Digital Electronics: Design and Analysis4th EditionMcGraw-Hill Education
5.R. P. JainDigital Electronics: Principles and Integrated Circuits1st Edition
McGraw-Hill Educ

E-Resources:

1. https://nptel.ac.in/courses/108102112
2. MIT OpenCourseWare – Circuits and Electronics.
3. All About Circuits (www.allaboutcircuits.com).

CO	CO Description	PO	PSO
CO1	Understand and explain the working of operational amplifiers and digital ICs through simulation and practical circuits	-	-
CO2	Design, implement, and analyse analog circuits such as amplifiers, filters, oscillators, and multivibrators using operational amplifiers and timers.	PO2(3) PO5(2)	PSO2(3) PSO3(3)
CO3	Design and implement combinational and sequential digital circuits including logic gates, adders, decoders, multiplexers, and counters using digital ICs.	PO2(3) PO4(3) PO5(3)	PSO2(3) PSO3(3)
CO4	Simulate Op-amp circuits for various applications using software.	PO4(3) PO5(3)	PSO2(3) PSO3(3)
CO5	Test, troubleshoot, and evaluate the performance of analog and digital circuits using appropriate laboratory instruments and measurement techniques.	PO2(3) PO4(3) PO5(3)	PSO1(3) PSO2(3) PSO3(3)

(1) = Low; (2) = Medium; (3) = High

26SDC02	Professional and Corporate Communication Skills	L	T	P	C
		0	0	2	-

Course Objectives:

- To develop effective verbal and professional communication skills.
- To enhance grammar, vocabulary, reading and listening abilities.
- To demonstrate effective speaking, presentation and group discussion skills.
- To prepare students for corporate communication and workplace interactions.
- To develop professional skills required for interviews, placements and corporate environments.

List of Activities

1. Professional Communication Fundamentals and Workplace Etiquette
2. Verbal Ability, Grammar and Vocabulary Enhancement
3. Reading Comprehension and Critical Verbal Reasoning
4. Listening Skills and Effective Workplace Conversations
5. Professional Speaking, Pronunciation and Presentation Skills
6. Group Discussion, Team Communication and Negotiation Skills
7. Corporate Email, Business Writing and Digital Communication
8. Resume Writing, Self-Introduction and Personal Branding
9. Interview Skills, Corporate Etiquette and Workplace Interaction
10. Mock Corporate Communication, Presentation and Placement Simulation

TOTAL : 30 PERIODS

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Observation and Record (20%), Practical (30%), Internal Examinations (50%)

References:

1. Meenakshi Raman & Sangeeta Sharma – Technical Communication: Principles and Practice, Oxford University Press.
2. M. Ashraf Rizvi – Effective Technical Communication, McGraw Hill.
3. Rajendra Pal & H. S. Korlahalli – Essentials of Business Communication, Sultan Chand.
Norman Lewis – Word Power Made Easy, Penguin.
4. John Seely – The Oxford Guide to Writing and Speaking, Oxford University Press.
5. Michael Swan – Practical English Usage, Oxford University Press.

E-resources:

1. https://nptel.ac.in/courses/112107291

CO	CO Description	PO	PSO
CO1	Apply verbal and professional communication techniques in workplace situations.	PO1 (3)	PSO1 (3)
CO2	Demonstrate effective reading, listening, speaking and presentation skills.	PO2 (1) PO3 (3)	PSO1 (3) PSO2 (2)
CO3	Construct professional emails, business documents and other forms of corporate communication.	PO1 (3) PO3 (3)	PSO1 (3) PSO2 (3)
CO4	Demonstrate effective participation in group discussions, interviews and professional interactions.	PO3 (3) PO5 (3)	PSO1 (3) PSO2 (3)
CO5	Develop professional communication profiles through resume preparation, personal branding and placement-oriented activities.	PO1 (3) PO2 (2) PO3 (3)	PSO1 (3) PSO2 (3)

(1) = Low; (2) = Medium; (3) = High

MANDATORY COURSES

26MCC01	Disaster Management and Safety Awareness	L	T	P	C
		1	0	0	-

Course Objectives:

To provide students with fundamental knowledge of natural and man-made disasters, disaster preparedness, risk reduction, emergency response, industrial safety and personal/community safety, enabling them to respond effectively during emergency situations

Unit I	Fundamentals of Disaster Management	3

Disaster, hazard, vulnerability and risk; types of disasters; disaster management cycle; prevention, mitigation, preparedness, response and recovery; disaster risk reduction and early warning systems.

Unit II	Natural Disasters	3

Earthquakes, tsunamis, floods, landslides, cyclones, thunderstorms, droughts and heat waves; causes and impacts; preparedness, mitigation, evacuation and emergency response.

Unit III	Industrial and Man-Made Disasters	3

Industrial hazards and accidents; fire and explosion; chemical leakage; electrical and machinery hazards; biological and transportation disasters; personal protective equipment; hazard identification and risk assessment.

Unit IV	Emergency Response and First Aid	3

Emergency action and evacuation plans; fire prevention and fire extinguishers; basic first aid; bleeding, burns, fractures, electric shock and heat-related emergencies; basic CPR awareness; emergency communication and rescue procedures.

Unit V	Safety and Community Resilience	3

Occupational, laboratory, workshop, road and electrical safety; disaster recovery and rehabilitation; community resilience; role of government agencies, NGOs and volunteers; disaster risk mapping, safety audit, emergency drills and institutional disaster management planning.

TOTAL : 15 PERIODS

Text Books:

1. R. B. Singh, Disaster Management, Rawat Publications, Jaipur, 2015
2. S. K. Singh, Disaster Management, A.K. Publications, New Delhi, 2017.

References:

1. M. M. S. Maheshwari, Disaster Management, Pointer Publishers, Jaipur, 2011.
2. B. K. Khanna, All You Wanted to Know About Disasters, New India Publishing Agency, New Delhi, 2005.
3. National Disaster Management Authority (NDMA), National Disaster Management Guidelines, Government of India.
4. Ministry of Home Affairs, National Disaster Management Plan, Government of India.
5. S. K. Sharma, Disaster Management and Preparedness, CBS Publishers & Distributors, New Delhi.

CO	CO Description	PO	PSO
CO1	Explain the concepts, types and phases of disaster management.	PO9 (2) PO11 (2)	PSO3 (3)
CO2	Identify disaster hazards, vulnerabilities and associated risks.	PO7 (3) PO9 (2)	PSO3 (3)
CO3	Apply appropriate preparedness and mitigation measures for different disasters.	PO9 (2) PO11 (2)	PSO3 (3)
CO4	Demonstrate basic emergency response, first aid, fire safety and evacuation procedures.	PO9 (3) PO10 (2)	PSO3 (3)
CO5	Develop awareness of industrial, occupational, environmental and community safety practices	PO9 (3) PO11 (3)	PSO3 (3)

(1) = Low; (2) = Medium; (3) = High

26MCC02	Gender Sensitization and Inclusive Society	L	T	P	C
		1	0	0	-

Course Objectives:

- To create awareness about gender equality, equity, diversity and social inclusion.
- To understand gender roles, stereotypes, discrimination and constitutional values.
- To familiarize students with gender-based violence, safety measures and relevant legal provisions.
- To promote respectful behaviour, empathy and equal opportunities in educational and professional environments.

Unit I	**Gender Concepts and Social Awareness**	**3**
Gender, sex and gender identity; gender roles and stereotypes; gender equality and equity; socialization and discrimination; importance of gender sensitivity.		
Unit II	**Gender and Constitutional Values**	**3**
Fundamental rights and duties; equality and non-discrimination; constitutional provisions for gender equality; dignity, freedom and social justice; relevant laws for protection against discrimination and harassment.		
Unit III	**Gender-Based Violence and Safety**	**3**
Types of gender-based violence; domestic violence, sexual harassment and cyber harassment; prevention and reporting mechanisms; workplace and institutional safety; role of Internal Complaints Committee (ICC).		
Unit IV	Inclusive Education and Workplace	**3**
Inclusive education; equal opportunities; diversity and inclusion; accessibility; respectful communication; prevention of bias and discrimination in educational institutions and workplaces.		
Unit V	Building an Inclusive Society	**3**
Role of students and professionals in promoting equality; empathy and responsible behaviour; gender-sensitive leadership; community awareness; case studies, group discussions and awareness activities.		
		TOTAL : 15 PERIODS

Text Books:

1. A. S. Altekar, The Position of Women in Hindu Civilization, Motilal Banarsidass, New Delhi.
2. B. R. Ambedkar, Annihilation of Caste, Navayana Publishing.

References:

1. United Nations, Gender Equality and Women's Empowerment, UN Publications.
2. Government of India, The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013.
3. National Commission for Women, Handbook on Sexual Harassment of Women at Workplace, Government of India.
4. UGC, Policy on Prevention, Prohibition and Redressal of Sexual Harassment of Women Employees and Students in Higher Educational Institutions.
5. UNESCO, Gender Equality and Education, UNESCO Publications.

CO	CO Description	PO	PSO
CO1	Explain the concepts of gender, gender equality, equity and social inclusion.	PO9 (2) PO11 (2)	PSO3 (3)
CO2	Identify gender stereotypes, discrimination and inequalities in society.	PO7 (3) PO9 (2)	PSO3 (3)
CO3	Understand constitutional provisions and legal mechanisms related to gender equality and safety.	PO9 (2) PO11 (2)	PSO3 (3)
CO4	Demonstrate respectful and inclusive behaviour in academic and workplace environments.	PO9 (3) PO10 (2)	PSO3 (3)
CO5	Promote gender-sensitive practices and contribute to building an equitable and inclusive society.	PO9 (3) PO11 (3)	PSO3 (3)

(1) = Low; (2) = Medium; (3) = High

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