SENGUNTHAR ENGINEERING COLLEGE
(AUTONOMOUS)
(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)
Recognized Under Section 2(f) & 12(B) of the UGC Act, 1956
NAAC Accredited with 'A' Grade
TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU

CURRICULUM & SYLLABI

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

(CHOICE BASED CREDIT SYSTEM)

REGULATIONS – 2023

(Revised)

(I – V Semesters)

(For the students admitted in the academic year 2023 – 2024 onwards)

Estd : 2001

Note: The regulations hereunder are subject to amendments as may be decided by the Academic Council of the Sengunthar Engineering College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates (including those already undergoing the program) as may be decided by the Academic Council.

10/9/2024
Chairman

10/9/2024
DEAN-ACADEMICS
SENGUNTHAR ENGINEERING COLLEGE
(AUTONOMOUS)
TIRUCHENGODE-637 205. NAMAKKAL-DT.

10/9/2024
PRINCIPAL
SENGUNTHAR ENGINEERING COLLEGE
(AUTONOMOUS)
TIRUCHENGODE - 637 205

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REGULATIONS 2023

CHOICE BASED CREDIT SYSTEM

B. E. ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

- To become a front-runner in bringing out globally competent innovators, researchers, and entrepreneurs in electrical and engineering.

MISSION

- To deliver exceptional quality undergraduate and doctoral programs in electrical and electronics engineering
- To provide state-of-the-art resources to achieve excellence in teaching-learning, research and economic development
- To bridge the gap between industry and academia for industrial and societal needs
- To enhance the creative talents of students to suite national and international standard
- To enable students and workforce to develop skills to solve complex technological problems of current times for promoting collaborative and multidisciplinary activities.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates can

- Apply their technical competence in Electrical science to solve real world problems, with technical.
- Conduct cutting edge research and develop solutions on problems of social relevance.
- Work in a business environment, exhibiting team skills, work ethics, adaptability and lifelong learning.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	**Problem analysis**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design / development of solutions**	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4	**Conduct investigations of complex problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO6	**The engineer and society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOME (PSOs)

PSO1	Ability to understand the principles and working of electrical components, circuits, systems and control that are forming a part of power generation, transmission, distribution, utilization, energy audit and conservation. Students can assess the power management, auditing, crisis and energy saving aspects.
PSO2	Competence to apply mathematical methodologies to solve problems related with electrical engineering using appropriate engineering tools and algorithms.
PSO3	Expertise to use knowledge in various domains to identify research gaps and hence to provide solutions.

MAPPING OF COURSE OUTCOME AND PROGRAM OUTCOME

Year	Sem	Course Name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I	23HST101 - Professional English	-	-	-	-	-	1.4	2.2	1.25	1.8	3.0	-	3.0	-	-	-
		23MAT101 - Matrices and calculus	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
		23HST102 - தமிழர்மரபு/ Heritage of Tamils	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		23PHE103 - Applied Physics for Electronics Engineering	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
		23CYE101 - Engineering Chemistry	1.6	1.6	2.4	1.25	1.8	1	2	-	-	-	-	1.5	-	-	-
		23GEE101 - Programming in C	2	2.3	2.3	1.16	2	1.7	1	1	2	1	2.8	2.3	1.8	2.2	-
		23EEC101 - Soft Skills & Life Skills	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		23MDC101 - Induction Program (2 Weeks)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	II	23MAT202 – Differential Equations and Numerical Methods	3	3	2	1	1	-	-	-	-	-	2	3	-	-	-
		23PHT203 – Advanced Physics for Electronics Engineering	3	2	1	1	1	1	1	-	-	-	-	-	-	-	-
		23CYT201 - Environmental Science and Sustainability	1.5	1.8	2.2	1.8	1.5	1.4	2.2	2	1	2	-	1	-	-	-
		23HST202-தமிழரும் தொழில்நுட்பமும்/ Tamils and Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		23HSE201 – English for Engineers: Theory and Practice	-	-	-	-	2	1.2	1.2	1	2	3	-	3	-	-	-
		23EEE201 – Electric Circuit Analysis	3	3	3	2.8	3	-	-	-	3	2	-	3	3	1	2
		23GEL201 - Engineering Practices Laboratory	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
		23GEL202 – Engineering Drawing for Electrical & Electronics	3	2	-	-	2	1	1	-	3	-	-	2	2	1	1
		23EEC201 – Indian Language (Except Mother Tongue / Foreign Language)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		23MDC201 – Aptitude Skills	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

MAPPING OF COURSE OUTCOME AND PROGRAM OUTCOME

Year	Sem	Course Name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
II	III	23MAT301 - Transforms and Complex Functions	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
		23EET301 - Electromagnetic Theory	3	3	3	2	2	-	2	1	-	1	-	2	3	-	3
		23EET302 - Measurements and Instrumentation	3	2	3	-	3	2	-	2	-	1	-	3	3	-	3
		23EEE301 - DC Machines and Transformers	3	3	2	2	2	-	-	-	3	1.3	-	3	3	1	2
		23EEE302 - Analog Electronics and Circuits	3	3	2	-	2	-	-	-	3	2.2	-	3	3	1	2
		23EEE303 - Digital Electronics and Linear Integrated Circuits	3	3	3	2.2	2	-	-	1	3	1.3	-	1	3	2	1
		23EEC301 - Professional Development	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	IV	23EET401 - Electrical Power Transmission and Distribution	3	3	2	2	1	1	-	1	-	1	-	2	3	-	2
		23EET402 - Power Electronics	3	3	3	3	-	-	1.6	1	-	1	-	2	3	-	2
		23EET403 – Control Systems Engineering	3	3	3	3	3	-	-	1	-	2	-	-	3	3	3
		23EEE401 – Micoprocessors and Microcontrollers	2	1	2	3	3	-	-	1	-	1	-	3	3	-	3
		23EEE402 - Induction and Synchronous Machines	3	3	1.6	2.3	3	-	-	1	3	2	-	2	3	3	2
		23GEE301 - Problem Solving and Python Programming	2.3	2.5	1.5	1.8	1.8	-	-	-	-	-	1.5	0.7	2.7	0.5	-
		23EEC401 – Online Certification Courses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

MAPPING OF COURSE OUTCOME AND PROGRAM OUTCOME

Year	Sem	Course Name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
III	v	23EET501 – Power System Analysis	3	3	3	3	2.2	1	2.2	-	-	-	-	2	3	-	3
		Professional Elective I 23EEP501 – Under Ground Cable	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
		23EEP502 – Power Quality	3	3	3	3	2	-	3	3	-	3	-	3	3	3	3
		23EEP503 – Flexible AC Transmission System	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
		23EEP504 - High Voltage Engineering	3	2	2	2	-	2	-	1	-	2	-	3	3	2	2
		23EEP505- Utilization of Electrical Energy	3	2	2	2	-	1	-	1	-	2	-	2	3	2	2
		23EEP506 - Smart Grid	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
		Professional Elective II 23EEP507 - SMPS And UPS	3	3	3	2	-	-	2	1	-	2	-	2	3	2	3
		23EEP508 - Special Electrical Machines	3	3	2	2	1	1	-	1	-	2	-	2	3	3	3
		23EEP509 - Multi Level Power Converter	**3**	2	2	2	1	-	-	1	-	2	-	2	3	2	2
		23EEP510 - Protection And Switchgear	3	3	2	2	1	-	-	2	-	2	-	2	3	2	2
		23EEP511 - Modern Power Converters	3	2	3	3	3	-	3	1	-	2	-	2	3	2	3
		23EEP512 - Power Electronics For Renewable Energy Systems	3	2	2	2	1	-	-	1	-	2	-	1	3	2	2
		Professional Elective III 23EEP513 - Discrete Time System And Signal Processing	3	3	3	2	-	-	2	1	-	-	-	2	3	-	3

		23EEP514 - Embedded System Design	3	2.2	2	2.2	1	-	-	-	-	-	-	-	2	1.4	2.6
		23EEP515 - Embedded C-Programming	3	2.2	2	2.2	1	-	-	-	-	-	-	-	2	1.4	2.6
		23EEP516 - Embedded Control For Electric Drives	2.4	1.6	2.4	2.4	1.8	-	-	-	-	-	-	-	2	2	2.6
		23EEP517 - Microcontroller Based System Design	**3**	**2**	**2**	**2**	**2**	-	-	-	-	**1**	-	**2**	**3**	**1**	**3**
		23EEP518 - Embedded System For Automotive Applications	2.4	3	2.4	2.4	2	-	-	-	-	-	-	-	1.8	1.8	2.6
		23EEE501 – Electrical Drives	2.3	2.5	1.5	1.8	1.8	-	-	-	-	-	1.5	0.7	2.7	0.5	-
		23EEE502 – Renewable Energy and Energy Storage Systems	3	3	-	2	2	2	2	1	2	2	-	2	3	2	3
		23EEC501 – Industrial Training	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		23MDC501 – Mandatory Course - I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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ESTD 2001
ISO 9001 REGISTERED

SCHEME FOR CURRICULUM

B.E.-Electrical and Electronics Engineering

SENGUNTHAR
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கற்க கசடற

CURRICULUM

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

B.E. - ELECTRICAL AND ELECTRONICS ENGINEERING - FIRST SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23HST101	Professional English	HS	3	0	0	3	40	60	100
23MAT101	Matrices and Calculus	BS	3	1	0	4	40	60	100
23HST102	தமிழர் மரபு/Heritage of Tamils	HS	1	0	0	1	40	60	100
EMBEDDED COURSE									
23PHE103	Applied Physics for Electronics Engineering	BS	3	0	2	4	50	50	100
23CYE101	Engineering Chemistry	BS	3	0	2	4	50	50	100
23GEE101	Programming in C	ES	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC101	Soft Skills & Life Skills	EEC	1	0	0	1	100	-	100
MANDATORY COURSE									
23MDC101	Induction Program (2 Weeks)	MC	-	-	-	-	-	-	-
TOTAL CREDITS IN SEMESTER - I			21						

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L : Lecture
T : Tutorial
P : Practical
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CURRICULUM

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

B.E. - ELECTRICAL AND ELECTRONICS ENGINEERING - SECOND SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23MAT202	Differential Equations and Numerical Methods	BS	3	1	0	4	40	60	100
23PHT203	Advanced Physics for Electronics Engineering	BS	3	0	0	3	40	60	100
23CYT201	Environmental Science and Sustainability	HS	3	0	0	3	40	60	100
23HST202	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HS	1	0	0	1	40	60	100
EMBEDDED COURSE									
23HSE201	English for Engineers: Theory and Practice	HS	3	0	2	4	50	50	100
23EEE201	Electric Circuit Analysis	PC	3	0	2	4	50	50	100
PRACTICALS									
23GEL201	Engineering Practices Laboratory	ES	0	0	4	2	60	40	100
23GEL202	Engineering Drawing for Electrical & Electronics	ES	0	0	4	2	60	40	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC201	Indian Language (Except Mother Tongue / Foreign Language)	EEC	0	0	4	2	100	-	100
MANDATORY COURSE									
23MDC201	Aptitude Skills	MC	3	0	0	0	-	-	-
TOTAL CREDITS IN SEMESTER II			25						

HS : Humanities and Social Sciences
BS : Basic Sciences
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OE : Open Elective
EEC : Employability Enhancement Courses
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FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – THIRD SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23MAT301	Transforms and Complex Functions	BS	3	1	0	4	40	60	100
23EET301	Electromagnetic Theory	PC	3	1	0	4	40	60	100
23EET302	Measurements and Instrumentation	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23EEE301	DC Machines and Transformers	PC	3	0	2	4	50	50	100
23EEE302	Analog Electronics and Circuits	PC	3	0	2	4	50	50	100
23EEE303	Digital Electronics and Linear Integrated Circuits	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC301	Professional Development	EEC	0	0	2	1	100	-	100
TOTAL CREDITS IN SEMESTER III			24						

HS : Humanities and Social Sciences
BS : Basic Sciences
ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
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OE : Open Elective
EEC : Employability Enhancement Courses
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CURRICULUM

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – FOURTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23EET401	Electrical Power Transmission and Distribution	PC	3	0	0	3	40	60	100
23EET402	Power Electronics	PC	3	0	0	3	40	60	100
23EET403	Control Systems Engineering	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23EEE401	Microprocessors and Microcontrollers	PC	3	0	2	4	50	50	100
23EEE402	Induction and Synchronous Machines	PC	3	0	2	4	50	50	100
23GEE301	Problem Solving and Python Programming	ES	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC401	Online Certification Courses	EEC	3	0	0	3	100	-	100
TOTAL CREDITS IN SEMESTER IV			24						

HS : Humanities and Social Sciences
BS : Basic Sciences
ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
GE : General Elective
OE : Open Elective
EEC : Employability Enhancement Courses
MC : Mandatory Courses
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P : Practical
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CURRICULUM

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – FIFTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23EET501	Power System Analysis	PC	3	1	0	4	40	60	100
	Professional Elective I	PE	3	0	0	3	40	60	100
	Professional Elective II	PE	3	0	0	3	40	60	100
	Professional Elective III	PE	3	0	0	3	40	60	100
EMBEDDED COURSE									
23EEE501	Electrical Drives	PC	3	0	2	4	50	50	100
23EEE502	Renewable Energy & Energy Storage System	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEC501	Industrial Training	EEC	0	0	4	2	100	-	100
MANDATORY COURSE									
23MDC501	Mandotory Course -I	MC	3	0	0	0	-	-	-
	TOTAL CREDITS IN SEMESTER V		23						

HS : Humanities and Social Sciences
BS : Basic Sciences
ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
GE : General Elective
OE : Open Elective
EEC : Employability Enhancement Courses
MC : Mandatory Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

CURRICULUM

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – SIXTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
	Professional Elective IV	PE	3	0	0	3	40	60	100
	Professional Elective V	PE	3	0	0	3	40	60	100
	Professional Elective VI	PE	3	0	0	3	40	60	100
	Open Elective – I / NCC L1 / L3	OE	3	0	0	3	40	60	100
EMBEDDED COURSE									
23EEE601	Power System Operation and Control	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEJ601	Project Work – Phase I	EEC	0	0	8	4	60	40	100
MANDATORY COURSE									
23MDC601	Mandatory Course - II	MC	3	0	0	0	-	-	-
TOTAL CREDITS IN SEMESTER VI			20						

HS : Humanities and Social Sciences
BS : Basic Sciences
ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
GE : General Elective
OE : Open Elective
EEC : Employability Enhancement Courses
MC : Mandatory Courses
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CURRICULUM

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

B.E.– ELECTRICAL AND ELECTRONICS ENGINEERING – SEVENTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23HST701	Human Values and Ethics	HS	3	0	0	3	40	60	100
	Elective-Management	GE	3	0	0	3	40	60	100
	Open Elective-II/NCC-II L2/ L4	OE	3	0	0	3	40	60	100
	Open Elective-III	OE	3	0	0	3	40	60	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEJ701	Project Work – Phase II	EEC	0	0	8	4	60	40	100
TOTAL CREDITS IN SEMESTER VII			16						

HS : Humanities and Social Sciences
BS : Basic Sciences
ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
GE : General Elective
OE : Open Elective
EEC : Employability Enhancement Courses
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CURRICULUM

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – EIGHTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
EMPLOYABILITY ENHANCEMENT COURSE									
23EEJ801	Product Development	EEC	0	0	12	6	60	40	100
23EEC801	Internship	EEC	0	0	4	2	100	-	100
TOTAL CREDITS IN SEMESTER VIII			8						

HS : Humanities and Social Sciences
BS : Basic Sciences
ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
GE : General Elective
OE : Open Elective
EEC : Employability Enhancement Courses
MC : Mandatory Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
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TOT : Total

LIST OF HUMANITIES AND SOCIAL SCIENCES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23HST101	Professional English	HS	3	0	0	3	40	60	100
23HST102	தமிழர்மரபு/Heritage of Tamils	HS	1	0	0	1	40	60	100
23CYT201	Environmental Sciences and Sustainability	HS	3	0	0	3	40	60	100
23HST202	தமிழரும் தொழில்நுட்பமும் /Tamil and Technology	HS	1	0	0	1	40	60	100
23HSE201	English for Engineers: Theory and Practice	HS	3	0	2	4	50	50	100
23HST701	Human Values Ethics	HS	3	0	0	3	40	60	100

LIST OF BASIC SCIENCES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MAT101	Matrices and calculus	BS	3	1	0	4	40	60	100
23PHE103	Applied Physics for Electronics Engineering	BS	3	0	2	4	50	50	100
23CYE101	Engineering Chemistry	BS	3	0	2	4	50	50	100
23MAT202	Differential Equations & Numerical Methods	BS	3	1	0	4	40	60	100
23PHT203	Advanced Physics for Electronics Engineering	BS	3	0	0	3	40	60	100
23MAT301	Transforms and Complex Functions	BS	3	1	0	4	40	60	100

LIST OF ENGINEERING SCIENCES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23GEE101	Programming in C	ES	3	0	2	4	50	50	100
23GEL202	Engineering Drawing for Electrical and Electronics	ES	0	0	4	2	60	40	100
23GEL201	Engineering Practices Laboratory	ES	0	0	4	2	60	40	100
23GEE301	Problem Solving and Python Programming	ES	3	0	2	4	50	50	100

LIST OF PROFESSIONAL CORE

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEE201	Electric Circuit Analysis	PC	3	0	2	4	50	50	100
23EET301	Electromagnetic Theory	PC	3	1	0	4	40	60	100
23EET302	Measurements and Instrumentation	PC	3	0	0	3	40	60	100
23EEE301	DC Machines and Transformers	PC	3	0	2	4	50	50	100
23EEE302	Analog Electronics and Circuits	PC	3	0	2	4	50	50	100
23EEE303	Digital Electronics and Linear Integrated Circuits	PC	3	0	2	4	50	50	100
23EET401	Electrical Power Transmission and Distribution	PC	3	0	0	3	40	60	100
23EET402	Power Electronics	PC	3	0	0	3	40	60	100
23EEE401	Microprocessors and Microcontrollers	PC	3	0	2	4	50	50	100
23EET403	Control Systems Engineering	PC	3	0	0	3	40	60	100
23EEE402	Induction and Synchronous Machines	PC	3	0	2	4	50	50	100
23EET501	Power System Analysis	PC	3	1	0	4	40	60	100
23EEE501	Electrical Drives	PC	3	0	2	4	50	50	100
23EEE502	Renewable Energy and Energy Storage System	PC	3	0	2	4	50	50	100
23EEE601	Power System Operation and Control	PC	3	0	2	4	50	50	100

LIST OF PROFESSIONAL ELECTIVE COURSES

PROFESSIONAL ELECTIVE - I

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEP501	Under Ground Cable	PE	3	0	0	3	40	60	100
23EEP502	Power Quality	PE	3	0	0	3	40	60	100
23EEP503	Flexible AC Transmission Systems	PE	3	0	0	3	40	60	100
23EEP504	High Voltage Engineering	PE	3	0	0	3	40	60	100
23EEP505	Utilization of Electrical Energy	PE	3	0	0	3	40	60	100
23EEP506	Smart Grid	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE - II

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEP507	SMPS and UPS	PE	3	0	0	3	40	60	100
23EEP508	Special Electrical Machines	PE	3	0	0	3	40	60	100
23EEP509	Multi Level Power Converter	PE	3	0	0	3	40	60	100
23EEP510	Protection and Switchgear	PE	3	0	0	3	40	60	100
23EEP511	Modern Power Converters	PE	3	0	0	3	40	60	100
23EEP512	Power Electronics for Renewable Energy System	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE - III

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEP513	Discrete Time System and Signal processing	PE	3	0	0	3	40	60	100
23EEP514	Embedded System Design	PE	3	0	0	3	40	60	100
23EEP515	Embedded C Programming	PE	3	0	0	3	40	60	100
23EEP516	Embedded Control for Electrical Drives	PE	3	0	0	3	40	60	100
23EEP517	Microcontroller Based System Design	PE	3	0	0	3	40	60	100
23EEP518	Embedded System for Automotive Applications	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE - IV

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEP601	Electric Vehicle Architecture	PE	3	0	0	3	40	60	100
23EEP602	Electric Vehicle Design, Mechanics and Control	PE	3	0	0	3	40	60	100
23EEP603	Design of Electric Vehicle Charging System	PE	3	0	0	3	40	60	100
23EEP604	Design of Motor and Power Converters for Electric Vehicles	PE	3	0	0	3	40	60	100
23EEP605	Electrical Vehicles	PE	3	0	0	3	40	60	100
23EEP606	Testing of Electric Vehicles	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE -V

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEP607	Process Modeling and Simulation	PE	3	0	0	3	40	60	100
23EEP608	Soft Computing	PE	3	0	0	3	40	60	100
23EEP609	Optimal Control	PE	3	0	0	3	40	60	100
23EEP610	Adaptive Control	PE	3	0	0	3	40	60	100
23EEP611	Computer Control of Process	PE	3	0	0	3	40	60	100
23EEP612	Machine Monitoring System	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE - VI

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEP613	Design of Electrical Apparatus	PE	3	0	0	3	40	60	100
23EEP614	Energy Storage Systems	PE	3	0	0	3	40	60	100
23EEP615	Grid Integrating Techniques and Challenges	PE	3	0	0	3	40	60	100
23EEP616	Hybrid Energy Technology	PE	3	0	0	3	40	60	100
23EEP617	Power Systems Transients	PE	3	0	0	3	40	60	100
23EEP618	PLC Programming	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVE COURSES

OPEN ELECTIVE - I

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MEO601	Introduction to Industrial Engineering	OE	3	0	0	3	40	60	100
23ECO602	Fundamentals of Electronic Devices and Circuits	OE	3	0	0	3	40	60	100

23EEO603	Electric Vehicle Technology	OE	3	0	0	3	40	60	100
23EEO604	Renewable Energy System	OE	3	0	0	3	40	60	100
23MEO605	CNC Machining Technology	OE	3	0	0	3	40	60	100
23MAO606	Graph Theory	OE	3	0	0	3	40	60	100
23CEO607	Environmental and Social Impact Assessment	OE	3	0	0	3	40	60	100
23PMO608	Pharmaceutical Nanotechnology	OE	3	0	0	3	40	60	100
23RAO609	Fundamentals of Robotics	OE	3	0	0	3	40	60	100
23CSO610	Introduction to Drone Technologies	OE	3	0	0	3	40	60	100
23MDO611	Hospital Management	OE	3	0	0	3	40	60	100
23CSO612	Cyber Forensics and Ethical Hacking	OE	3	0	0	3	40	60	100

OPEN ELECTIVE- II

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23HSO701	English for Competitive Examinations	OE	3	0	0	3	40	60	100
23MGO702	Democracy and Good Governance	OE	3	0	0	3	40	60	100
23MEO703	Fundamentals of Mechatronics	OE	3	0	0	3	40	60	100
23CEO704	Remote Sensing Concepts	OE	3	0	0	3	40	60	100
23MEO704	Nano Technology	OE	3	0	0	3	40	60	100
23MDO705	Ultrasound Principles and its Medical Applications	OE	3	0	0	3	40	60	100
23PMO706	Intellectual Property Rights	OE	3	0	0	3	40	60	100
23RAO707	Mobile Robots	OE	3	0	0	3	40	60	100
23ECO708	Energy Technology	OE	3	0	0	3	40	60	100
23EEO709	Sensors , Actuators and its application	OE	3	0	0	3	40	60	100
23MAO710	Operations Research	OE	3	0	0	3	40	60	100
23CSO711	Cyber Security	OE	3	0	0	3	40	60	100
23MEO712	3D Printing and Design	OE	3	0	0	3	40	60	100

OPEN ELECTIVE - III

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23HSO713	Project Report Writing	OE	3	0	0	3	40	60	100
23MAO714	Advanced Numerical Methods	OE	3	0	0	3	40	60	100
23CSO715	Fundamentals of Block Chain Technology	OE	3	0	0	3	40	60	100
23EEO716	Electrical, Electronic and Magnetic Materials	OE	3	0	0	3	40	60	100
23CEO717	Geographical Information System	OE	3	0	0	3	40	60	100
23ECO718	VLSI Design	OE	3	0	0	3	40	60	100
23MDO719	Wearable Technology	OE	3	0	0	3	40	60	100
23MEO720	Marine Vehicles	OE	3	0	0	3	40	60	100
23RAO721	Nano Materials and Application	OE	3	0	0	3	40	60	100
23MGO722	Cost Management of Engineering Projects	OE	3	0	0	3	40	60	100
23MDO723	Medical Waste Management	OE	3	0	0	3	40	60	100
23MDO724	Lifestyle Diseases	OE	3	0	0	3	40	60	100

GENERAL ELECTIVES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23NCCL01	NCC AIRFORCE LEVEL-1	GE	3	0	0	3	40	60	100
23NCCL02	NCC AIRFORCE LEVEL - 2	GE	3	0	0	3	40	60	100
23NCCL03	NCC ARMY LEVEL - 3	GE	3	0	0	3	40	60	100
23NCCL04	NCC ARMY LEVEL - 4	GE	3	0	0	3	40	60	100

ELECTIVE - MANAGEMENT

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MGT701	Principles of Management	GE	3	0	0	3	40	60	100
23MGT702	Total Quality Management	GE	3	0	0	3	40	60	100
23MGT703	Engineering Economics and Financial Accounting	GE	3	0	0	3	40	60	100
23MGT704	Human Resource Management	GE	3	0	0	3	40	60	100
23MGT705	Knowledge Management	GE	3	0	0	3	40	60	100
23MGT706	Industrial Management	GE	3	0	0	3	40	60	100
23MGT707	Supply Chain Management	GE	3	0	0	3	40	60	100
23MGT708	e-Waste Management	GE	3	0	0	3	40	60	100

LIST OF EMPLOYABILITY ENHANCEMENT COURSES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23EEC101	Soft Skills & LifeSkills	EEC	1	0	0	1	100	-	100
23EEC201	Indian Language (Except Mother Tongue / Foreign Language)	EEC	0	0	4	2	100	-	100
23EEC301	Professional Development	EEC	0	0	2	1	100	-	100
23EEC401	Online Certification Courses	EEC	3	0	0	3	100	-	100
23EEC501	Industrial Training	EEC	0	0	4	2	100	-	100
23EEJ601	Project Work - Phase I	EEC	0	0	8	4	60	40	100
23EEJ701	Project Work - Phase II	EEC	0	0	8	4	60	40	100
23EEJ801	Product Development	EEC	0	0	12	6	60	40	100
23EEC801	Internship	EEC	0	0	4	2	100	-	100

LIST OF MANDATORY COURSES

MANDATORY COURSES - I

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MDC501	Introduction to Women and Gender Studies	MC	3	0	0	0	-	-	-
23MDC502	Elements of Literature	MC	3	0	0	0	-	-	-
23MDC503	Film Appreciation	MC	3	0	0	0	-	-	-
23MDC504	Disaster Risk Reduction and Management	MC	3	0	0	0	-	-	-
23MDC505	Constitution of India	MC	3	0	0	0	-	-	-

MANDATORY COURSES - II

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23MDC601	Well Being with Traditional Practices- Yoga, Ayurveda and Siddha	MC	3	0	0	0	-	-	-
23MDC602	History of Science and Technology in India	MC	3	0	0	0	-	-	-
23MDC603	Political and Economical Thought for a Human Society	MC	3	0	0	0	-	-	-
23MDC604	State, Nation Building and Politics in India	MC	3	0	0	0	-	-	-
23MDC605	Industrial Safety	MC	3	0	0	0	-	-	-

SCHEME

Credit Summary

CURRICULUM AND SYLLABI

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

CREDIT SUMMARY

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Category	Credits Per Semester								Credit Total
	I	II	III	IV	V	VI	VII	VIII	
HS	4	8	-	-	-	-	3	-	15
BS	12	7	4	-	-	-	-	-	23
ES	4	4	-	4	-	-	-	-	12
PC	-	4	19	17	12	4	-	-	56
PE	-	-	-	-	9	9	-	-	18
OE	-	-	-	-	-	3	6	-	9
GE	-	-	-	-	-	-	3	-	3
EEC	1	2	1	3	2	4	4	8	25
MC	0	0	0	0	0	0	0	0	0
Total	21	25	24	24	23	20	16	8	161

SENGUNTHAR ENGINEERING COLLEGE
(AUTONOMOUS)
(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)
Recognized Under Section 2(f) & 12(B) of the UGC Act, 1956
NAAC Accredited with 'A' Grade
TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU
ESTD 2001
ISO 9001 REGISTERED

SCHEME FOR SYLLABI

B.E - Electrical and Electronics Engineering

SENGUNTHAR
Shrine 2 Success
கற்க கசடற

SEMESTER I

23HST101	**PROFESSIONAL ENGLISH**	**LT P C**
	(Common to all B.E. & B.Tech. Branches)	**3 0 0 3**

OBJECTIVES

- To develop learning English language through grammar.
- To use grammar efficiently for demonstrating all the four language skills (LSRW).
- To write business letters, dialogue writing, paragraph and essay writing.
- To speak effectively about self introduction and real time situation.
- To build the reading skills through reading comprehension and note taking

UNIT I VOCABULARY **8**

Synonyms and Antonyms - Word Formation - Sentence Types (declarative, imperative, interrogative & exclamatory) - Single Word Substitutes - Use of Abbreviations and Acronyms - Homonyms and Homophones - Collocation - British and American Vocabulary.

UNIT II GRAMMAR **10**

Parts of speech - Be, Have and Do verbs - Punctuation - Tenses - Numerical Adjectives - modal verbs - Single line Definition - Direct and Indirect Speech - Gerunds and Infinitives - Same Word Used as Different Parts of Speech.

UNIT III WRITING **9**

Letter Writing - Business communications - quotations, placing orders, complaints, replies to queries from business customers - Dialogue Writing – Paragraph Writing (descriptive, narrative, expository & persuasive) - Essay Writing - Writing Instructions.

UNIT IV SPEAKING **9**

Self-introduction - Giving personal and factual information - Talking about present circumstances, past experiences and future plans - Expressing opinions and justifying opinions - Agreement / disagreement - Likes and dislikes - Tongue twisters

UNIT V READING SKILLS **9**

Reading Comprehension – Reading techniques, pre-reading, post-reading, comprehension questions (multiple choice questions or short questions) - Short Comprehension Passages, practice skimming - Scanning and Predicting - Reading the passage and taking (Note making) Notes - Scan and understand main contents of the passage.

TOTAL: 45 PERIODS

Mandatory activity: Self Introduction

OUTCOMES

Upon completion of the course, the students will be able to:

- Use a wide range of vocabulary in oral and written communication
- Frame grammatically correct sentences.
- Write letters, frame paragraphs and Essays, develop conversation.
- Develop the speaking skills for self-Introduction, delivering speeches and Technical Presentation
- Read and comprehend the passage, technical content and take notes

TEXT BOOKS

1. Board of Editors. Using English A Course book for Under graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2 ,2015.

REFERENCES

1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers", Orient Black Swan, First Edition, 2012.
2. Mac Millan, Krishna Mohan, Meera Banerji, Developing Communication Skills, Paperback, 2019.

E-RESOURCES

1. http://www.usingenglish.com
2. https://www.khanacademy.org/humanities/grammar

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	1	3	1	2	3	-	3	-	-	-
2	-	-	-	-	-	1	2	-	1	3	-	3	-	-	-
3	-	-	-	-	-	3	3	2	3	3	-	3	-	-	-
4	-	-	-	-	-	1	2	1	2	3	-	3	-	-	-
5	-	-	-	-	-	1	1	1	1	3	-	3	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	-	-	-	-	-	**1.40**	**2.20**	**1.25**	**1.80**	**3.00**	-	**3.00**	-	-	-

1- Low 2-Medium 3-High '-' – No Correlation

23MAT101 **MATRICES AND CALCULUS** **LT P C**
(Common to all B.E. & B.Tech. Branches) **3 1 0 4**

OBJECTIVES

- To develop the use of matrix algebra techniques those are needed by engineers for practical applications.
- To familiarize the students with differential and integral calculus.
- To describe the student with functions of several variables.
- To acquire the student with mathematical tools needed in evaluating multiple integrals and their applications.
- To acquaint the student with the concepts of vector calculus that is needed for the problems in engineering disciplines.

UNIT I MATRICES **9+3**

Eigen values and Eigen vectors - Properties of Eigen values - Cayley-Hamilton theorem - Reduction of quadratic form to canonical form by orthogonal transformation - Nature of quadratic form.

UNIT II DIFFERENTIAL AND INTEGRAL CALCULUS **9+3**

Differentiation rules: Derivatives of polynomials and exponential functions - The product and quotient Rules - Derivatives of trigonometric functions - The Chain rule - Implicit differentiation - Applications of differentiation: Maximum and Minimum Values - Techniques of integration: Integration by parts - Trigonometric integrals - Integration of rational functions by partial fractions.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+3**

Partial derivatives - Homogeneous functions - Euler's theorem - Total derivative - Jacobians – Taylor's theorem for functions of two variables - Maxima and minima of functions of two variables - Lagrange's method of undetermined multipliers.

UNIT IV MULTIPLE INTEGRALS **9+3**

Double integrals - Change of order of integration - Double integrals in polar coordinates - Area enclosed by plane curves - Triple integrals - Volume of solids - Change of variables in double integrals.

UNIT V VECTOR CALCULUS **9+3**

Scalar and vector point functions - Gradient - Divergence and curl - Line integral - Surface integral - Green's theorem in a plane - Volume integral - Divergence theorem - Irrotational and Solenoidal fields.

LIST OF TUTORIALS

1. Computation of Eigen values and Eigenvectors.
2. Calculate differentiation and integration of simple functions.
3. Determining Maxima and minima of functions for two variables.
4. Evaluating double and triple integrals.
5. Computing Gradient, divergence and curl of point functions.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Classify the matrix algebra methods for solving practical problems.
- Discover differential calculus tools in solving various application problems and compare different methods of integration in solving practical problems.
- Develop differential calculus ideas on several variable functions.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.
- Solve engineering problems using the concept of vector calculus.

TEXT BOOKS

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, Fourty Third Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, New Delhi, Seventh Edition, 2015.

REFERENCES

1. Bali N.P, Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, Seventh Edition, 2009.
2. Kanti B. Dutta., “Mathematical Methods of Science and Engineering – Aided with MATLAB”, Cengage Learning, New Delhi, First Edition, 2013.

E-RESOURCES

1. https://nptel.ac.in/courses/111105121 - (Differential Calculus and Integral Calculus)
2. https://nptel.ac.in/courses/111107112 - (Matrix analysis)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
2	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
3	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
4	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
5	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**	**-**

1-Low 2-Medium 3-High '-' – No Correlation

23HST102 **HERITAGE OF TAMILS** **LT P C**
1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages - Tamil as a Classical Language - Classical Literature in Tamil - Secular Nature of Sangam Literature - Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils..

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15 PERIODS

TEXT BOOKS

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

4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

REFERENCE BOOKS

1. Heritage of Tamils, Published by: Yes Dee Publishing Pvt Ltd, Chennai
2. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

23HST102 **தமிழர் மரபு** **LT P C**
1 0 0 1

UNIT I மொழி மற்றும் இலக்கியம் **3**

இந்திய மொழி குடும்பங்கள் - திராவிட மொழிகள் -தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தில் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம்- திருக்குறளில் மேலாண்மை கருத்துக்கள் -தமிழ் காப்பியங்கள் - தமிழகத்தில் பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம் ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலயக்யத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

UNIT II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை- சிற்பக்கலை **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினை பொருட்கள் ,பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புற தெய்வங்கள் - குமரி முனையில் திருவள்ளுவர் சிலை - இசை கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம், தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

UNIT III நாட்டுப்புற கலைகள் மற்றும் வீர விளையாட்டுகள் **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவை கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

UNIT IV தமிழர்களின் திணைகோட்பாடுகள் **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறகோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவு, கல்வியும் - சங்க கால நகரங்களும் துறை முகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

UNIT V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்கு தமிழர்களின் பங்களிப்பு **3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ்பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் -

இந்திய மருத்துவத்தில், சித்தமருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ் புத்தகங்களின் வரலாறு

TOTAL: 15 PERIODS

TEXT BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் -கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினி தமிழ் -முனைவர் இல சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

REFERENCE BOOKS

1. தமிழர் மரபு - முனைவர் ஆ பூபாலன் (வி ஆர்பி பி பப்ளிஷர்ஸ்)

23PHE103 APPLIED PHYSICS FOR ELECTRONICS ENGINEERING LT P C
(Common to ECE, EEE & Medical Electronics) **3 0 2 4**

OBJECTIVES

- To recognize different lattices and crystal structures
- To explore the principles of lasers and the uses for them in general.
- To build knowledge about optical fibre and its applications.
- To understand the applications of acoustics and ultrasonics in industry.
- To utilize Schrödinger's wave equation and the fundamentals of quantum mechanics to investigate the complicated physical phenomena.
- To analyze the engineering physics that may be used to calculate thermal properties, substance characteristics, optics, acoustics, and ultrasonics.

UNIT I CRYSTAL PHYSICS 9

Lattice and Unit cell - Crystal Systems and Bravais Lattice - Lattice Planes - Miller Indices - d -Spacing in Cubic Lattice - Calculation of Number of Atoms per Unit Cell - Atomic Radius, Coordination number, Packing factor for SC, BCC, FCC and HCP Structures - Crystal Growth Techniques : Melt Growth Techniques (Bridgman and Czochralski).- Silicon chip Production Process.

UNIT II PHOTONICS 9

Spontaneous and Stimulated Emission - Population Inversion - Derivation of Einstein's A and B co-efficient - Principle and Working of He Ne Laser - Direct Band gap and Indirect Bandgap Semiconductors - Semiconductor Diode Laser (Homo junction & hetero junction) - Applications of Lasers in Science, Engineering and Medicine - Digital Laser Material Processing Technology.

UNIT III FIBRE OPTICS 9

Principle and Propagation light in Optical Fibres - Derivation of Numerical Aperture and Acceptance angle - Fibre Optic Communication System - Classification of Optical Fibres - Fibre optic sensors. (Pressure, Temperature Sensors)-Local area Network (qualitative) - Advantages & Application of Optical Fibre.

UNIT IV ACOUSTICS & ULTRASONICS 9

ACOUSTICS: Classification of Sound - Decibel - Weber Fechner law- Reverberation- Sabine's formula (Concept only) - Factors affecting Acoustics of Buildings and their remedies.

ULTRASONICS: Properties -Production of ultrasonic's - Magnetostriction and Piezoelectric methods - Non Destructive Testing: Pulse Echo System, through Transmission and Reflection modes - Medical Endoscope.

UNIT V QUANTUM PHYSICS **9**

Black Body Radiation - Planck's Theory (Derivation) - Electron Diffraction - Wave function and its Physical Significance - Schrödinger's Wave Equation: Time Independent and Time Dependent Equations - Scanning Electron Microscope - Transmission Electron Microscope - Quantum Tunneling & Scanning Tunneling Electron Microscope.

LIST OF EXPERIMENTS

(Common to ECE EEE & Medical Electronics)
(Eight experiments are to be conducted in Lab)

1. Determination of wavelength of laser.
2. Determination of particle Size lycopodium powder using laser.
3. Fibre Optics: Determination of Numerical Aperture and Acceptance angle.
4. Determination of wavelength of mercury spectrum- Spectrometer.
5. Determination of velocity of ultrasonic in liquid.
6. Verification of truth tables of logic gates using IC's: (OR, AND, NOT, XOR, NOR and NAND)
7. Determination of thickness of wire - Air wedge method.
8. Determination of bandgap of a given semiconductor diode.
9. Determination of reverse bias characteristics of the photodiode. (Virtual)
10. Compact disc- Determination of width of the groove using laser. (virtual)

TOTAL: 45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of this course, students will be able to;

- Apply crystallographic knowledge to get familiar with the structure of crystalline solids.
- Learn the basics of lasers and their use in some applications
- Acquire knowledge about fibre optics and apply it to various fields
- Understand the basics of Acoustic, Ultrasonic's and estimate the applications in diverse fields.
- Apply the basic principles of quantum mechanics and Schrödinger's wave equation to study the complex physical phenomenon.
- Relate elasticity, optics, and semiconductor physics in engineering applications.

TEXT BOOKS

1. P.Mani, "Engineering Physics Practicals", Dhanam Publications, 2019.
2. Rajendiran V, "Engineering Physics" Tata McGraw Hill, 2012.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", Mc Graw Hill, Indian Edition, 2017.

REFERENCES

1. Avadhanulu M.N & Kshirsagar P.G, "Text Book of Engineering Physics", S.Chand, 2006.
2. Wahab, M.A, "Solid State Physics: Structure and Properties of Materials" Narosa Publishing House, 2009.
3. K.Thyagarajan and A.Ghatak. "Lasers: Fundamentals and Applications", Laxmi Publications, Indian Edition, 2019.

E-RESOURSES

1. https://archive.nptel.ac.in/courses/122/107/122107035/
2. https://archive.nptel.ac.in/courses/115/101/115101107/

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
2	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
5	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
6	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
AVG	3	**3**	1	1	-	-	-	-	-	-	-	-	-	-	-

1- Low 2-Medium 3-High '-' – No Correlation

23CYE101 **ENGINEERING CHEMISTRY** **LT P C**

(Common to CSE, EEE, ECE, CSE (CS), MDE, AIDS, IT & PT) **3 0 2 4**

OBJECTIVES

- To classify the impurities of water and the treatment and the conditioning methods for domestic and industrial uses.
- To develop an understanding the fundamentals of polymers.
- To gain knowledge the phase rule and its applications in engineering field.
- To explain the basics of Nano chemistry, synthesis, properties and applications of the nano materials.
- To be familiar with the types of corrosion and the control measures and working of batteries.
- To inculcate practical skills in the determination of water quality parameters and instrumental analysis.

UNIT I WATER TECHNOLOGY **9**

Introduction - Characteristics - Hardness - Estimation of hardness by EDTA method - Alkalinity and its estimation - Boiler feed water - Requirements - Boiler troubles (Scale and Sludge) - Internal conditioning (phosphate, calgon and carbonate conditioning methods) - External conditioning - Zeolite process, Demineralization process - Desalination of brackish water by reverse osmosis.

UNIT II POLYMER CHEMISTRY **9**

Introduction - Classification of polymers - Natural and Synthetic; Thermoplastic and Thermosetting plastic. Functionality - Degree of polymerization. Types of polymerization: Addition Condensation and Copolymerization, Property of polymer: Glass transition temperature, Preparation, properties and uses of PVC, Nylon 6,6, Polyethylene - Rubbers - Types - Vulcanization of rubber - Plastics - Moulding constituents of plastics - Moulding of plastics - Compression and injection - Biodegradable polymers-Conducting polymers.

UNIT III PHASE RULE AND ALLOYS **9**

Phase rule - Explanation of terms involved - One component system - Water system - Condensed phase rule - Simple eutectic systems (Lead - Silver system only). Alloys: Introduction - Definition - Properties of alloys - Significance of alloying, functions and effect of alloying elements - Ferrous alloys - Nichrome and stainless steel - Heat treatment of steel, non-ferrous alloy - Brass.

UNIT IV CHEMISTRY OF NANO MATERIALS **9**

Nano chemistry - Basics (Surface area to volume ratio - Distinction between molecules, nanoparticles and bulk materials - Characterization of nanomaterials using EDX and HR-TEM. Synthesis of nano materials: Top down approach - Ball milling - Bottom up approach - Sol-gel method, Chemical vapour deposition - Applications of nanomaterials (Nano products of today).

UNIT V ELECTROCHEMISTRY, CORROSION AND ITS CONTROL 9

Introduction - Electrochemical cells, applications of electrochemical series - Reference Electrode-standard calomel electrode, ion selective electrode, glass electrode, Corrosion - Types - Chemical Corrosion - Electrochemical Corrosion (galvanic and differential aeration) - Factors influencing corrosion - Material selection and design aspects - Control methods of corrosion - sacrificial anodic and impressed current cathodic protection.

LIST OF EXPERIMENTS

(Any Eight Experiments to be conducted)

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by Argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Estimation of sodium and potassium present in water using flame photometer.
7. Conductometric Precipitation Titration using $BaCl_2$ and Na_2SO_4.
8. Conductometric titration of strong acid vs strong base.
9. Estimation of Ferrous ions by Potentiometric Titration.
10. Estimation of copper content in the brass by Iodometry.

TOTAL:45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to

- Infer the quality of water and Identify the method of removal of impurities from water for domestic and industrial purpose.
- Identify the different types of polymers, polymerization processes and some special properties and applications of polymers.
- Apply the knowledge of phase rule to alloy making for various engineering applications.
- Discuss the fundamentals of the nano materials and apply the basic concepts of nano chemistry in engineering applications.
- Analyze the causes of corrosion, suggest the control measures and discuss the functions of batteries.
- Determine the water quality parameters and perform quantitative chemical analysis by pH metery, flame photometry, conductometry and potentiometry.

TEXT BOOKS

1. Jain P.C and Monika Jain, “Engineering Chemistry”, Dhanpet Rai Publishing Company (P) Ltd. New Delhi, Seventeenth Edition, 2015.
2. Viswanathan B, "Nanomaterials", Alpha Science International Ltd, 2009.
3. O.G. Palanna, “Engineering Chemistry”, McGraw Hill Education (India) Private Limited, Second Edition, 2017.

REFERENCES

1. S.S.Dara, S.S.Umare, “A Textbook of Engineering Chemistry”, S.Chand & Company Ltd, New Delhi, 2015.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/104105084
2. http://library.iitbbs.ac.in/open-access-e-resources.php

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	3	-	1	-	3	-	-	-	-	2	-	-	-
2	1	-	2	-	1	-	-	-	-	-	-	-	-	-	-
3	2	2	3	1	1	1	-	-	-	-	-	1	-	-	-
4	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-
5	2	1	2	1	3	-	1	-	-	-	-	-	-	-	-
6	2	3	-	2	3	-	-	-	-	-	-	-	-	-	-
AVG	1.6	1.6	2.4	1.25	1.8	1	2	-	-	-	-	1.5	-	-	-

1-Low 2-Medium 3-High ‘-‘ – No Correlation

23GEE101 **PROGRAMMING IN C** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To understand the constructs of C language.
- To study arrays and strings for developing C programs.
- To know the functions and pointers application in C programs.
- To understand the concepts of structures and Union.
- To understand input/output and file handling in C.
- To develop programs and applications using C.

UNIT I BASICS OF C PROGRAMMING **9**

Introduction to programming paradigms - Structure of C program - C programming: Data Types - variables - Storage classes - Constants - Enumeration Constants - Keywords - Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements - Decision making statements - Switch statement - Looping statements - Pre-processor directives - Compilation process.

UNIT II ARRAYS AND STRINGS **9**

Introduction to Arrays: Declaration, Initialization - One dimensional array - Example Program**:** Computing Mean, Median and Mode - Two dimensional arrays - Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String operations: length, compare, concatenate, copy - Sorting - Selection sort, Insertion sort, Merge sort, quick sort - Searching - linear and binary search.

UNIT III FUNCTIONS AND POINTERS **9**

Introduction to functions: Function prototype, function call, Built-n functions (string functions, math functions) - Recursion - Example Program: Computation of Sine series, Scientific calculator using built-in functions - Pointers - Pointer operators - Arrays and pointers - Example Program: Sorting of names - Parameter passing: Pass by value, Pass by reference - Example Program: Swapping of two numbers and changing the value of a variable using pass by reference.

UNIT IV STRUCTURES **9**

Structure - Example Programs - Nested structures - Pointer in Structures - Array of structures - Example Program using structures and pointers - Self referential structures - Dynamic memory allocation.

UNIT V FILE PROCESSING **9**

Files - Operations of File - Types of file processing: Sequential access, Random access - Sequential access file - Random access file - Command line arguments.

LIST OF EXPERIMENTS

(Any Eight Experiments to be conducted)

1. Programs using I/O statements, expressions and decision–making constructs.
2. Write a program to find whether the given year is leap year or Not.
3. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
4. Check whether a given number is Armstrong number or not?
5. Given a set of numbers like <10, 36, 54, 89, 12, 27>, find sum of weights based on the following conditions.
   a) 5 if it is a perfect cube.
   b) 4 if it is a multiple of 4 and divisible by 6.
   c) 3 if it is a prime number.
6. Sort the numbers based on the weight in the increasing order as shown below <10,its weight>, <36,its weight> <89,its weight>
7. Populate an array with height of persons and find how many persons are above the average height.
8. From a given paragraph perform the following using built–in functions:(i)Find the total number of words.(ii)Capitalize the first word of each sentence.(iii)Replace a given word with another word.
9. Solve towers of Hanoi using recursion.
10. Locate and Display the Contents of an Array using Pointers.
11. Generate salary slip of employees using structures and pointers.
12. Count the number of account holders whose balance is less than the minimum balance using sequential access file.

TOTAL: 45 +15 = 60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to,

- Build C programs for simple applications using basic constructs,
- Develop C programs using arrays and strings.
- Construct C programs involving functions, recursion and pointers
- Implement applications in C programs using structures.
- Develop applications in C using file processing.
- Develop applications using C programming constructs.

TEXT BOOKS

1. E. Balagurusamy, “Programming in ANSI C”, Tata McGraw Hill, Eigth Edition, 2019.
2. Kernighan, B.W and Ritchi D.M, “The C Programming language”, Pearson Education, Second Edition, 2006.

REFERENCES

1. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Juneja, B. L and Anita Seth, "Programming in C", CENGAGE Learning India pvt.Ltd., First Edition, 2011.

E – RESOURCES

1. https://nptel.ac.in/courses/106/105/106105085/ - (Introduction to C Programming)
2. https://nptel.ac.in/courses/106/106/106106210/ - (Stack Operations)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	1	2	1	1	1	2	-	3	2	1	2	-
2	2	2	2	1	2	1	1	1	2	-	3	3	2	2	-
3	2	3	2	1	2	1	1	1	2	-	3	2	2	2	-
4	3	2	2	1	3	1	1	1	2	-	3	3	2	2	-
5	2	3	3	1	2	1	2	1	2	-	3	2	2	3	-
6	2	2	3	2	1	2	-	-	2	1	2	2	2	2	-
AVG	2	2.3	2.3	1.16	2	1.7	1	1	2	1	2.8	2.3	1.8	2.2	-

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER II

23MAT202 DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS LT P C
[Common to Civil, EEE, ECE and MDE] **3 1 0 4**

OBJECTIVES

- To acquire the knowledge of techniques in solving the ordinary differential equations obtained from engineering problems.
- To understand the purpose of Laplace transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- To know the basic concepts of solving algebraic and transcendental equations.
- To study the numerical techniques of interpolation and integration.
- To learn various techniques in solving ordinary differential equations.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS AND RECURRENCE RELATIONS 9+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Legendre's linear equations – Simultaneous linear equations with constant coefficients – Recurrence relations: Solving linear homogeneous recurrence relations with constant coefficients.

UNIT II LAPLACE TRANSFORMS 9+3

Definition – Conditions for existence – Transforms of elementary functions – Properties of Laplace transforms – Transform of Periodic functions – Transforms of derivatives and integrals – Multiplication by t^n and division by 't' – Evaluation of integrals by Laplace transforms – Inverse transforms – Convolution theorem – Application to solution of linear second order ordinary differential equations with constant coefficients.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations by Newton Raphson method – Solution of simultaneous algebraic equations by Gauss elimination, Gauss Jordan and Gauss Seidel methods – Matrix Inversion by Gauss Jordan method – Eigen values of a matrix by Power method.

UNIT IV INTERPOLATION AND NUMERICAL INTEGRATION 9+3

Interpolation with equal intervals: Newton's forward interpolation formula – Newton's backward interpolation formula – Interpolation with unequal intervals: Lagrange's interpolation formula – Divided differences – Newton's divided difference formula – Numerical integration: Trapezoidal rule – Simpson's one-third rule – Numerical double integration by Trapezoidal rule.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Taylor's series method – Euler's method – Modified Euler's method – Runge-Kutta method – Predictor-corrector methods: Milne's method – Adams-Bashforth method.

LIST OF TUTORIALS

1. Solving ordinary differential equations
2. Calculate Laplace transform of simple functions.
3. Solution of linear system of equations by Gauss Seidel methods.
4. Evaluation of line integrals by Trapezoidal rule.
5. Solution of ordinary differential equations by Euler's method.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply various techniques in solving ordinary differential equations which arises in engineering problems.
- Build the Laplace transforms techniques in solving differential equations.
- Develop the concepts of solving algebraic and transcendental equations.
- Apply the numerical techniques of interpolation and integration for engineering problems.
- Solve ordinary differential equations with initial conditions by using certain techniques.

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, Forty fourth Edition, 2022.
2. Grewal, B.S., "Numerical Methods in Engineering and Science", Khanna Publishers, Eleventh Edition, 2023.

REFERENCES

1. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, Tenth Edition, 2016.
2. Burden, R.L and Faires, J.D, "Numerical Analysis", Cengage Learning, Nineth Edition, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/111/105/111105121/ - (Ordinary differential equations)
2. https://nptel.ac.in/courses/111106139 - (Laplace transforms)
3. https://nptel.ac.in/courses/111/107/111107105/ - (Numerical Methods)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	1	-	-	-	-	-	2	3	-	-	-
2	3	3	2	1	1	-	-	-	-	-	2	3	-	-	-
3	3	3	2	1	1	-	-	-	-	-	2	3	-	-	-
4	3	3	2	1	1	-	-	-	-	-	2	3	-	-	-
5	3	3	2	1	1	-	-	-	-	-	2	3	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	3	2	1	1	-	-	-	-	-	2	3	-	-	-

1-Low 2-Medium 3-High '-' – No Correlation

23PHT203 ADVANCED PHYSICS FOR ELECTRONICS ENGINEERING LT P C
(Common to ECE, EEE & Medical Electronics) **3 0 0 3**

OBJECTIVES

- To learn the basic conduction process in conducting materials
- To understand the fundamentals of semiconducting materials and plastic electronics.
- To understand the fundamentals of Magnetic and Superconducting materials.
- To study the concept of Spintronics & Nano Electronic Devices
- To know the basics of Biophotonics and Biomaterials.

UNIT I CONDUCTING MATERIALS & DIELECTRIC MATERIALS 9

Conductors – Classical Free Electron Theory of Metals – Electrical and Thermal Conductivity – Wiedemann – Franz law, Lorentz number – Draw backs of Classical Theory. Dielectric Materials: Electrical Susceptibility – Dielectric constant – Electronic, Ionic, Orientation and Space Charge Polarization- Internal filed and Clausius-Mosotti Relation.

UNIT II SEMICONDUCTING MATERIALS & PLASTIC ELCTRONICS 9

Elemental and Compound Semiconductors – Intrinsic Semiconductor & Extrinsic semiconductor – Carrier concentration derivation in Intrinsic Semiconductor - Hall effect and applications. Plastic Electronics: Introduction - Materials for Plastic Electronics - Conducting Polymers and Organic Semiconductors - Fabrication Techniques - Organic Light Emitting Diodes (OLEDs) - Organic Field Effect Transistors (OFETs).

UNIT III MAGNETIC & SUPERCONDUCTING MATERIALS 9

Electron theory of magnetism; Dia, Para, Ferromagnetism and their Properties- Domain theory of Ferromagnetism – Hard and Soft magnetic Materials - Superconductivity: Properties – Type I and Type II Superconductors – BCS theory of superconductivity – General applications of Superconductors – Cryotron and Magnetic levitation.

UNIT IV SPINTRONICS & NANO ELECTRONIC DEVICES 9

Introduction- Quantum confinement- Quantum well, Quantum Wire and Quantum Dot structure – Tunnelling: Single Electron Phenomena and Single Electron Transistor (SET) - Spintronics – Quantum Dot Laser- Quantum Bits (qubits)- Quantum Computing- Carbon Nano Tubes (CNT) structure, Properties and applications - Concepts of Graphene Transistor – Carbon nano tube transistor (qualitative) - Applications of Nanodevices and Nanosensors.

UNIT V BIOPHOTONICS & BIOMATERIALS 9

BIOPHOTONICS: Basic principles of light - Reflection - Refraction - Absorption - Polarization - Interference – Coherence- Principles of Optical biosensing - Immobilization of Bio-recognition elements-Types of Optical Biosensor

BIOMATERIALS: Definition and classification of Bio-Material- Viscoelasticity and biomaterial performance- Stainless Steel Alloys and its applications- Biopolymers and its Applications - Shape Memory Alloys.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of this course, students will be able to:

- Develop knowledge on conducting and dielectric materials.
- Discuss the fundamentals of plastic electronics, semiconductor physics, and how these technologies are used in many types of electronic devices.
- Analyze the uses of magnetic and superconducting materials.
- Develop knowledge about spintronics and nano electronic devices
- Discuss the fundamentals of biophotonics and biomaterials.

TEXT BOOK

1. Rajendran V, "Engineering Physics", Tata McGraw Hill Publications, 2015.
2. R,Murugesan, Er. Kiruthiga Sivaprasath, "Modern Physics", S.Chand, Tenth Edition, 2019.
3. Gupta and Kumar, "Solid State Physics", K. Nath & Co, 2018.

REFERENCES

1. Sujata V. Bhatt, "Biomaterials", Narosa Publishing House, Seventh Edition, 2016.
2. Avadhanulu M.N & Kshirsagar P.G, "Text Book of Engineering Physics", S.Chand, 2015.
3. Charles Kittel, "Introduction to Solid State Physics", Wiley, 2019.
4. D.N. Vasudeva, "Electricity and Magnetism" S.Chand & Co, Twelfth Edition, 2017.

E – RESOURCES

1. https://archive.nptel.ac.in/courses/115/101/115101092/
2. https://nptel.ac.in/courses/108104113

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	1	1	1	-	-	-	-	-	-	-	-
2	3	2	1	1	1	1	1	-	-	-	-	-	-	-	-
3	3	2	1	1	1	1	1	-	-	-	-	-	-	-	-
4	3	2	1	1	1	1	1	-	-	-	-	-	-	-	-
5	3	2	1	1	1	1	1	-	-	-	-	-	-	-	-
AVG	3	2	1	1	1	1	1	-	-	-	-	-	-	-	-

1- Low 2-Medium 3-High '-' – No Correlation

23CYT201 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY LT P C
(Common to All B.E /B.Tech Branches) **3 0 0 3**

OBJECTIVES

- To understand the importance of the environment, the ecosystem, biodiversity and its conservation.
- To study the various kinds of pollutions, solid waste management and precautionary measures for disasters.
- To learn the social issues and identify the possible way to improve the quality of the environment.
- To understand the problems of overpopulation and understand the value education.
- To know the concept of sustainability and implement sustainable practices in various fields.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – Need for public awareness - Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (d) aquatic ecosystems (oceans) – Introduction to biodiversity definition: genetic, species and ecosystem diversity –Value of biodiversity – Threats to biodiversity – Endangered and endemic species of India – Conservation of biodiversity: In-Situ and Ex-Situ conservation of biodiversity.

Activity: Biodiversity in and around the campus and report submission.

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution – Solid waste management: causes, effects and control measures of municipal solid wastes - E-waste – Role of an individual in prevention of pollution - Pollution case studies – Disaster management: floods, earthquake and cyclone.

Activity: Local pollution case study and report submission.

UNIT III SOCIAL ISSUES AND THE ENVIRONMENT 9

Water conservation, rain water harvesting, watershed management – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Green Chemistry and principles - Environment production act – Air (Prevention and Control of Pollution) act –Water (Prevention and control of Pollution) act

Activity: Creating environmental awareness.

UNIT IV HUMAN POPULATION AND THE ENVIRONMENT 9

Population growth, variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – Women and child welfare – Role of information technology in environment and human health – Case studies.

Activity: Visit to local primary health center.

UNIT V SUSTAINABLE MANAGEMENT 9

Sustainability - Concept, needs and challenges-economic, social and aspects of sustainability-From unsustainability to sustainability-—-Sustainable Development Goals-Targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-Case studies. Zero waste, Material Life cycle assessment, Sustainable habitat: Energy efficiency, Sustainable transports.

Activity: Field trips to local organizations or facilities with sustainable practices in place.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply knowledge on public awareness & about the environment, ecosystem and biodiversity.
- Find solutions for pollutions and waste management to improve the quality of environment.
- Identify the causes of social issues and apply the concept of green chemistry to maintaining a clean environment.
- Analyze the effects of human population and issues related to the environment and human health.
- Identify with the different goals of sustainable development and apply them for suitable technological advancement and societal development.

TEXT BOOKS

1. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, 2019.
2. Gilbert M.Masters, “Introduction to Environmental Engineering and Science”, Pearson Education, Eighth Edition, 2021.
3. Allen, D. T. and Shonnard, D. R., “Sustainability Engineering: Concepts, Design and Case Studies”, Prentice Hall, Third Edition, 2018.

REFERENCES

1. Erach Bharucha, “Textbook of Environmental Studies”, Universities Press (I) Pvt Ltd, 2016.
2. Dharmendra S. Sengar, “Environmental law”, Prentice hall of India Pvt Ltd, 2018.
3. Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/122102006/
2. https://swayam.gov.in/nd1_noc19_ge22/preview

Mapping of COs-POs & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	1	3	2	-	1	3	-	1	-	-	1	-	-	-
2	2	2	2	2	2	2	1	-	-	-	-	-	-	-	-
3	-	2	2	2	1	1	3	-	-	-	-	-	-	-	-
4	1	2	2	1	1	2	3	3	-	-	-	-	-	-	-
5	-	2	2	2	2	1	1	1	-	2	-	-	-	-	-
AVG	1.5	1.8	2.2	1.8	1.5	1.4	2.2	2	1	2	-	1	-	-	-

1-Low 2-Medium 3-High ‘-‘ – No Correlation

23HST202 **TAMILS AND TECHNOLOGY** **LT P C**
1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)-ThirumalaiNayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project

TOTAL: 15 PERIODS

TEXT BOOKS

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

4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

REFERENCE BOOKS

1. Heritage of Tamils, Published by: Yes Dee Publishing Pvt Ltd, Chennai
2. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

23HST202 **தமிழரும் தொழில்நுட்பமும்** **LT P C**
1 0 0 1

அலகு I **நெசவு மற்றும் பானைத் தொழில்நுட்பம்:** 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:** 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III **உற்பத்தித் தொழில் நுட்பம்:** 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்:** 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்:** 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

TEXT BOOKS

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

REFERENCE BOOKS

1.தமிழரும் தொழில்நுட்பமும், முனைவர் கே பூபாலன் வி ஆர் பி பப்ளிஷர்ஸ்

23HSE201 ENGLISH FOR ENGINEERS:THEORY AND PRACTICE LT P C

(Common to all B.E. & B.Tech. Branches) **3 0 2 4**

OBJECTIVES

- To use grammatical components effectively in spoken and written communication.
- To read and understand technical writing.
- To develop the skills for writing email, business letters, Job Application Letter and the resume.
- To write checklist and recommendation.
- To speak fluently in real contexts.
- To acquire presentation skills and interview skills to face challenges in the career.

UNIT I GRAMMAR 9

Articles - Prepositions - Conditionals - Subject verb agreement - Error Spotting - Active and Passive voice.

UNIT II LISTENING & READING 9

Syllabification - Improving Vocabulary - Reading Newspapers - Listening to Youtube Documentaries - Listening to Podcast - Listening to Motivational Movies.

UNIT III WRITING 9

Checklist - Recommendations - Formal letters – inviting guests – acceptance/declining letters

UNIT IV BUSINESS WRITING 9

E-mail writing - fixing an appointment, cancelling appointment, paper submission for seminars and conferences - Job Application Letter and Resume.

UNIT V SPEAKING 9

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging - Suggesting - Comparing and Contrasting - Situational Role-play.

LIST OF EXERCISES

1. Stage Dynamics (Body Language and Paralanguage - Presentation)
2. Day today real time speaking exposures – Story narration, simple, general topics and incidents.
3. Group Discussion
4. Power Point Presentation (Corporate Skills & Public Speaking)
5. Loud Reading

6. Picture Description
7. Interview Skills (Mock Interview & Interview Etiquette)
8. Case Study Report

TOTAL: 45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Use grammar to frame sentences and write sentences.
- Use vocabulary, Read newspaper and demonstrate listening skills effectively.
- Draft emails, Business Letters, Job application letter and construct Résumé.
- Frame Checklist and Recommendations
- Develop speaking skill for taking part in collaborative task and situational Role-play.
- Demonstrate communication skills effectively in both formal and informal situations

TEXT BOOKS

1. S. Sumant, Maven Learning Private Limited, "Technical English II"
2. Joshi, Manmohan, *Soft Skills*, First Edition. Bookboon, 2017.

REFERENCES

1. Dr K Elango, Dr. Veena Selvam, Dr. Sujatha Priyadarshini, “Resonance English for Engineers and Technologists”, Cambridge University Press, First Edition, 2013.
2. Seely, John. Oxford, “Guide to Effective Writing and Speaking”, Indian ed. New Delhi: Oxford University Press. 2005.

E-RESOURCES

1. https://www.fluentu.com/Blog/english/english-small-talk
2. https://www.britishcouncil.com

EXTENSIVE READING

1. Stephen R. Covey, "The 7 Habits of Highly Effective People", Simon & Schuster, 2019.

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	1	1	-	2	3	-	3	-	-	-
2	-	-	-	-	2	1	1	1	2	3	-	3	-	-	-
3	-	-	-	-	2	1	2	1	2	3	-	3	-	-	-
4	-	-	-	-	-	1	1	1	1	3	-	3	-	-	-
5	-	-	-	-	-	2	1	1	3	3	-	3	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	-	-	-	-	2.00	1.20	1.20	1.00	2.00	3.00	-	3.00	-	-	-

1- Low 2-Medium 3-High '-' – No Correlation

Course Assessment methods for Continuous Internal Assessment:

S.No.	Assessment	Method	Marks
1.	Continuous Internal Assessment 1	Theory	**50**
2.	Continuous Internal Assessment 2	Practical	**50**
3.	Continuous Internal Assessment 3	Theory	**50**

During Practical (50 Marks)

- Speaking test will be conducted for 20 marks
- Reading test will be conducted for 20 marks
- Listening test will be conducted for 10 marks

23EEE201	ELECTRIC CIRCUIT ANALYSIS (Lab Embedded Theory Course)	LT P C 3 0 2 4

OBJECTIVES

- To learn basic concepts, basic laws and methods of analysis of DC and AC circuits.
- To understand the various methods of circuit analysis using network theorems.
- To know the concept of resonance and coupled circuits.
- To learn the steady state and transient response of RLC circuits.
- To study the balanced and unbalanced three phase circuits.
- To know hands-on experience in theorems and transient circuits.

UNIT I BASIC CIRCUIT ANALYSIS 9

Introduction DC and AC Circuits - Basic circuit elements - Ohm's Law - Kirchhoff's laws - Voltage and Current division - Source Transformation - Resistors in series and parallel circuits - Star-delta transformation - Mesh and nodal analysis for DC Circuits

UNIT II NETWORK THEOREMS 9

Thevenin's and Norton's Theorem - Superposition Theorem - Maximum power transfer theorem - Reciprocity Theorem

UNIT III RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance - Frequency response - Quality factor and Bandwidth - Self and mutual inductance - Dot rule - Coefficient of coupling - Analysis of coupled circuits.

UNIT IV TRANSIENT ANALYSIS 9

Natural response - Forced response - Transient response of RL, RC and RLC circuits using Laplace transform for DC input and AC sinusoidal input.

UNIT V THREE PHASE CIRCUITS 9

Average and RMS value - Phasor diagram - Power, Power factor and Energy - Analysis of three phase star and delta connected circuits with balanced and unbalanced loads - Power and Power factor measurements.

LIST OF EXPERIMENTS

1. Simulation and Experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and Experimental verification of electrical circuit problems using Thevenin's theorem and Norton's theorem.
3. Simulation and Experimental verification of electric circuit problems using Superposition theorem and Maximum Power transfer Theorem.
4. Simulation and Experimental validation of R-C electric circuit transients

5. Simulation and Experimental validation of frequency response of RLC electric circuit.
6. Simulation of three phase balanced and unbalanced star, delta networks circuits
7. Calibration of single phase Energy meter.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Discuss the basic concepts of DC and AC electrical circuits.
- Apply the knowledge of network theorems for simplifying the electric circuits.
- Compute the parameters of resonance and coupled circuits.
- Apply the concepts in transients.
- Analyze the parameters of three phase circuits.
- Design and apply circuit theorems and concepts in engineering applications.

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, Tata McGraw Hill publishers, New Delhi, Nineth Edition, 2020.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, McGraw Hill, Second Edition, 2019.

REFERENCES

1. Chakrabati A, “Circuits Theory (Analysis and synthesis)”, Dhanpat Rai Publishing Co Pvt Ltd, New Delhi, Seventh Edition, 2019.
2. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Tata McGraw Hill, Fifth Edition, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/108102042/ - (Circuit Theory)
2. https://nptel.ac.in/courses/108104139/ - (Basic Electric Circuit)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	-	-	-	-	2	-	3	3	1	2
2	3	3	3	3	-	-	-	-	-	2	-	3	3	1	2
3	3	3	3	3	-	-	-	-	-	2	-	3	3	1	2
4	3	3	3	3	-	-	-	-	-	2	-	3	3	1	2
5	3	3	3	3	-	-	-	-	-	2	-	3	3	1	2
6	3	3	3	3	3	-	-	-	3	2	-	3	3	1	2
AVG	3	3	3	2.8	3	-	-	-	3	2	-	3	3	1	2

1-Low 2-Medium 3-High '-' – No Correlation.

23GEL201	ENGINEERING PRACTICES LABORATORY (Lab Embedded Theory Course)	LT P C 0 0 4 2

OBJECTIVES

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planning and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

a) Introduction to switches, fuses, indicators and lamps - Basic switch boardwiring with lamp, fan and three pin socket
b) Staircase wiring

c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac /Triac /quadric)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

Assembling a centrifugal pump.
Assembling a household mixer.
Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study an elements of smart phone..
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop.

TOTAL: 60 PERIODS

OUTCOMES

Upon completion of this course, the students will be able to:

CO1: Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2: Wire various electrical joints in common household electrical wire work.

CO3: Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.

CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
4	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
AVG	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

1-Low 2-Medium 3-High '-' – No Correlation.

23GEL202 ENGINEERING DRAWING FOR ELECTRICAL AND ELECTRONICS **LT P C**
(Common For ECE, EEE & MDE) **0 0 4 2**

OBJECTIVES

- To know about the multiple views of engineering components.
- To learn to draw the projection of solids viewed in different positions.
- To learn the drawing knowledge of an electrical appliance.
- To know about the software for drafting and modeling of electronic components.
- To learn the softwares for designing the Human Anatomy & Ortho implantable models.

LIST OF EXPERIMENTS

1. Conversion of isometric views into orthographic
2. Conversion of orthographic views into isometric
3. Projection of solids - Hexagonal pyramid.
4. Projection of solids - Square prism.
5. Draw Fluorescent lamp wiring diagram and layout.
6. Draw staircase wiring diagram and layout.
7. Design and Implementation of NOR/XOR
8. Layout diagram of CMOS inverter and CMOS NAND gate.
9. Design of Human Anatomical structures.
10. Design of orthotics model.

TOTAL: 30 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Construct multiple views of engineering components.
- Develop the projection of solids.
- Design and develop the circuit connections of an electrical appliance.
- Design, analyze and simulate electronics components using Hardware and Software.
- Create precise and detailed technical drawings, simulate designs, and create digital prototypes for Healthcare Industry.

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	2	1	1	-	3	-	-	2	2	1	1
2	3	2	-	-	2	1	1	-	3	-	-	2	2	1	1
3	3	2	-	-	2	1	1	-	3	-	-	2	2	1	1
4	3	2	-	-	2	1	1	-	3	-	-	2	2	1	1
5	3	2	-	-	2	1	1	-	3	-	-	2	2	1	1
AVG	3	2	-	-	2	1	1	-	3	-	-	2	2	1	1

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER III

23MAT301	**TRANSFORMS AND COMPLEX FUNCTIONS** (Common to all B.E. & B.Tech. Branches)	**L T P C** **3 0 2 4**

OBJECTIVES

- To explain Fourier transforms techniques used in wide variety of situations.
- To utilize effective mathematical tools to develop Z transform techniques for discrete time systems.
- To apply Fourier series to many applications in engineering to solve boundary value problems.
- To develop the fundamental concepts in analytic functions, conformal mapping and bilinear transformations.
- To extend the standard techniques of complex integration.

UNIT I FOURIER TRANSFORMS **9+3**

Statement of Fourier integral theorem - Fourier transform - Fourier sine and cosine transforms - Properties of Fourier transform - Convolution theorem for Fourier transform - Parseval's identity for Fourier transform

UNIT II Z-TRANSFORMS AND DIFFERENCE EQUATIONS **9+3**

Z-transforms: Some standard Z-transforms - Elementary properties - Some useful Z-transforms and inverse Z- transforms - Convolution theorem - Evaluation of Inverse Z-transforms by partial fraction method - Application to difference equations.

UNIT III FOURIER SERIES **9+3**

Euler's formulae - Conditions for a Fourier expansion - Functions having points of discontinuity - Odd and even function - Half range series - Parseval's formula - Practical Harmonic analysis.

UNIT IV ANALYTIC FUNCTIONS **9+3**

Cauchy-Riemann equations - Analytic functions - Properties of analytic functions - Harmonic functions - Orthogonal system - Construction of analytic functions - Bilinear transformation - Conformal transformation by w = 1/z.

UNIT V COMPLEX INTEGRATION **9+3**

Cauchy's theorem - Cauchy's integral formula - Taylor's and Laurent's series - Residues: Residue theorem - Calculation of residues - Evaluation of real definite integrals: Integration around the unit circle.

LIST OF TUTORIALS

1. Calculate Fourier transform of simple functions.
2. Solve difference equations by Z transforms.

3. Computation of Fourier series coefficient.
4. Determination of Bilinear transformation for the given set of points.
5. Calculate complex line integration.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze some of the physical problems of engineering by Fourier transforms.
- Apply Z transforms techniques in solving difference equation.
- Solve differential equations using Fourier series analysis.
- Develop the concept of analytic functions, conformal mapping and the bilinear transformations.
- Evaluate integrals using Cauchy's integral formula and residue theorem.

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, Forty Third Edition, 2014.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Tenth Edition, John Wiley, India, 2016.

REFERENCES

1. N. P. Bali. and Manish Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications Pvt. Ltd, Nineth Edition, 2014.
2. Dr.Kandasamy. P, Dr.Thilagavathy.K andDr. Gunavathy.K., "Engineering Mathematics - Volume III", S. Chand and Company Ltd., New Delhi, 2010.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/111/102/111102129/# (Transforms)
2. https://archive.nptel.ac.in/courses/111/105/111105134/ (Complex functions)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
2	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
3	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
4	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
5	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	3	1	-	2	-	-	1	2	-	-	2	-	-	-

1-Low 2-Medium 3-High '-' – No Correlation

23EET301 **ELECTROMAGNETIC THEORY** **LT P C**
3 1 0 4

OBJECTIVES

- To learn the basic mathematical concepts related to electromagnetic vector fields.
- To understand the concepts of electrostatics and time varying fields.
- To know about the concepts of magnetostatics and time varying fields.
- To study the concepts of Faraday‘s law, induced emf and Maxwell‘s equations.
- To learn and solve fields and electromagnetic waves propagation problems.

UNIT I VECTOR ANALYSIS **9+3**

Sources and effects of electromagnetic fields - Scalar and Vector fields - Coordinate systems: Rectangular, Cylindrical and Spherical - Relationship between coordinate systems - Gradient, Divergence and Curl - Divergence theorem - Stoke’s theorem - Simulation on coordinate systems.

UNIT II ELECTROSTATICS **9+3**

Coulomb’s Law - Electric field intensity and Electric potential: due to point and continuous charges - Electric field and potential due to finite line charge, circular disc and infinite sheet of charge, two concentric shells and coaxial cylinders - Electric flux density - Gauss’s law and applications - Electric field in dielectric and equipotential plots - Electric Dipole - Electric field in multiple dielectrics - Boundary conditions, Poisson’s and Laplace’s equations, Capacitance, Energy density, Applications.

UNIT III MAGNETOSTATICS **9+3**

Lorentz force, Magnetic field intensity (H) - Biot–Savart’s Law - Ampere’s Circuit Law - H due to straight conductors, Circular loop, Infinite sheet of current, Magnetic flux density (B) - B in free space, conductor, magnetic materials - Magnetization, Magnetic field in multiple media - Boundary conditions, Scalar and Vector potential, Poisson’s Equation, Magnetic force, Torque, Inductance, Energy density - Finite Element Method Magnetic (FEMM) simulation tool - Applications.

UNIT IV ELECTRODYNAMIC FIELDS **9+3**

Magnetic Circuits - Faraday’s law - Transformer and motional EMF - Conduction and Displacement current - Maxwell’s equations (Differential and Integral form) - Ohm’s law in point form - Relation between field theory and circuit theory - Applications.

UNIT V ELECTROMAGNETIC WAVES **9+3**

Electromagnetic wave generation and equations - Wave parameters, velocity, intrinsic impedance, propagation constant - Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector - Plane wave reflection and refraction - Standing Wave - Applications.

TOTAL : 45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Design the basic mathematical concepts related to electromagnetic vector fields.
- Develop basic laws of electrostatics to various applications and to determine force, electric field intensity.
- Analyze the principles of magnetostatics to the solutions of problems relating to magnetostatic fields.
- Summarize the concepts of electrodynamics & to derive and discuss the Maxwell's equations.
- Apply Maxwell's equations to solutions of problems relating to wave propagation.

TEXT BOOKS

1. Mathew N. O. Sadiku, "Principles of Electromagnetics", Oxford University Press Inc. First India, Seventh Edition, 2020.
2. William H. Hayt and John A.Buck, "Engineering Electromagnetics", Tata McGraw Hill Nineth Revised Edition, 2020.

REFERENCES

1. Joseph. A.Edminister, "Schaum's Outline of Electromagnetics", Schaum's Outline Series), Tata McGraw Hill, Second Edition, 2017.
2. K A Gangadhar, "Electromagnetic Field Theory", Khanna Publishers, Eighth Reprint, 2019.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/108/104/108104087/ - (Electromagnetic Theory).
2. https://nptel.ac.in/courses/108106157 - (Transmission lines and Electromagnetic Waves).

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	-	2	1	-	1	-	2	3	-	3
2	3	3	3	2	-	-	2	1	-	1	-	2	3	-	3
3	3	3	3	2	2	-	2	1	-	1	-	2	3	-	3
4	3	3	3	2	-	-	2	1	-	1	-	2	3	-	3
5	3	3	3	2	-	-	2	1	-	1	-	2	3	-	3
AVG	3	3	3	2	2	-	2	1	-	1	-	2	3	-	3

1-Low 2-Medium 3-High '-' – No Correlation.

23EET302 MEASUREMENTS AND INSTRUMENTATION LT P C
3 0 0 3

OBJECTIVES

- To learn the fundamental concepts and characteristics of measurement and errors.
- To understand the knowledge on the functional aspects of measuring instruments.
- To study the importance of various bridge circuits used with measuring instruments.
- To know the overall measurement and instrumentation with the knowledge on digital instrumentation principles.
- To learn the fundamental working of sensors and transducers and their applications.

UNIT I INTRODUCTION 9

Functional elements of an instrument - Static characteristics: true value, static error, static correction, reproducibility, drift, repeatability, noise, signal to noise ratio, accuracy and precision, sensitivity, linearity, threshold, dead zone, resolution - Dynamic characteristics: speed of response, fidelity, lag, dynamic error - Errors: gross error, systematic error and random error - Statistical evaluation of measurement data – Standards and calibration.

UNIT II ELECTRICAL AND ELECTRONICS INSTRUMENTS 9

Principle and operation of analog voltmeters and ammeters: Moving iron: Attraction and repulsion type instruments. Moving coil instruments; PMMC, Dynamometer type, torque equation - Single phase dynamometer type watt meter, toque expression - Single phase induction type energy meters - Measurement of power using instrument transformers - Single phase electro-dynamometer power factor meters and Weston frequency meter.

UNIT III COMPARATIVE METHODS OF MEASUREMENTS 9

DC bridges: Wheatstone bridge, Kelvin's double bridge, Megger - AC bridges: Maxwell"s, Anderson, Schering, Wien - Transformer ratio & Self - balancing bridges - Interference & Screening - Multiple earths and earth loops - Electrostatic and electromagnetic interference - Grounding techniques - Basic Script based Matlab Programming

UNIT IV DIGITAL INSTRUMENTS AND DISPLAY DEVICES 9

Digital voltmeter: Ramp, Integrating and Successive approximation - Digital multi-meter - CRT display, dot matrix display, LED and LCD display - Digital energy meter - Digital Storage Oscilloscope (DSO) - Mixed Signal Oscilloscope (MSO) - Recorders: X-Y graphic recorders - Q-meter - Data loggers - Smart meters.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers - Selection of transducers - Resistive, capacitive and inductive transducers - Measurement of temperature - RTD, thermistors and thermocouples - Piezoelectric transducers - Digital transducers - Optical encoders - Elements of data acquisition system - Smart sensors.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Develop knowledge on basic functional elements of instrumentation.
- Analyze the concepts of fundamentals of electrical and electronic instrument.
- Compare between various measurements techniques.
- Explain the various storage and display devices.
- Determine the various concept of transducers and data acquisition systems.

TEXT BOOKS

1. A.K.Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai & Co, Second Edition, 2021.
2. R.K.Rajput, "Electrical Measurements and Measuring Instruments", S.Chand and Company Pvt. Ltd. Fourth Edition, 2018.

REFERENCES

1. D.V.S. Moorthy, "Transducers and Instrumentation", Prentice Hall of India Pvt Ltd, Third Edition, 2022.
2. E.O.Doebelin, "Measurement Systems - Application and Design", Tata McGraw Hill Publishing Company, Sixth Edition, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/108105153/ - (Electrical Measurement and Electronic Instruments)
2. https:// nptel.ac.in/courses/108105064/ - (Industrial Instrumentation)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	-	2		2	-	1	-	3	3	-	3
2	3	-	3	-	-	-	-	-	-	1	-	3	3	-	3
3	3	-	3	-	3	2	-	-	-	1	-	3	3	-	3
4	3	-	3	-	-	-	-	2	-	1	-	3	3	-	3
5	3	-	3	-	-	-	-	-	-	1	-	3	3	-	3
AVG	3	2	3	-	3	2	-	2	-	1	-	3	3	-	3

1-Low 2-Medium 3-High '-' – No Correlation

23EEE301	DC MACHINES AND TRANSFORMERS	LT P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

- To learn working principles of electrical machines with concepts of electro mechanical energy conversion.
- To understand the construction, principle of operation and the characteristics of DC generators.
- To study the working principle, characteristic and starting of DC motor.
- To learn the construction, working principles, testing and efficiency of transformer.
- To study the performance of DC machines and the transformers with different testing methods.
- To provide the hands on experience to evaluate the performance parameters of DC machines and transformer by conducting suitable tests.

UNIT I BASIC CONCEPTS IN ROTATING MACHINES 9

Magnetic circuits and calculations - Statically and dynamically induced EMF - Principle of electromechanical energy conversion forces and torque in magnetic field systems - Energy balance in magnetic circuits - Magnetic force- co-energy in singly excited and multi excited magnetic field system.

UNIT II DC GENERATORS 9

Construction - Principle of operation - E.M.F equations - Types of DC Generators - Characteristics of DC generators - Losses and Efficiency - Armature reaction - Commutation and inter poles - Compensating winding - Simulation on DC Machine Characteristics.

UNIT III DC MOTORS 9

Principle and operations - Back E.M.F. - Types of DC motors - Characteristics of DC Motors - Starting and speed control of DC motors - Plugging, Dynamic and Regenerative braking - Types of Starter - Necessity of Starters - Applications of DC motors.

UNIT IV TRANSFORMERS 9

Construction - Principle of operation - E.M.F Equation - Transformer ratio - Transformer on no Load - Transformer on load - Equivalent circuit – Losses and Efficiency - All day efficiency.- Regulation - Three phase transformers connections - Phasing of transformer - Parallel operation of transformers - Auto transformer - Simulation on Three phase Transformers.

UNIT V TESTING OF DC MACHINES AND TRANSFORMERS 9

Testing of DC Machines: Brake test, Swinburne's test, Retardation test, Hopkinson's test and Field's test for series motor - Testing of transformers: Load test, open circuit and short circuit test.

LIST OF LAB EXPERIMENTS

1. Open circuit and load characteristics of Self-Excited DC shunt generator.
2. Load test of DC shunt and series motor.
3. Load test on DC compound motor.
4. Speed control of DC shunt motor.
5. Swinburne's test of DC shunt motor.
6. Load test on single-phase transformer.
7. Open circuit and short circuit tests on single phase transformer.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Determine the basic concepts of electro mechanical energy conversion and concepts in rotating machines.
- Analyze the construction, principle of operation, methods of excitation and characteristics of DC generators.
- Demonstrate the knowledge on working principle, characteristic, starting and speed control of DC motors.
- Discuss the information about construction, working principles of transformer.
- Analyze load test and speed control in DC machines and transformers.
- Develop the circuit with appropriate connections for the given DC machines and transformers.

TEXT BOOKS

1. B.L.Thereja and A.K.Theraja, "A Text of Electrical Technology", S.Chand publications, Volume 1 & 2, 2021.
2. D P Kothari and I.J Nagarath, "Electrical Machines", McGraw Hill Education (India) Private Limited, Tenth Edition, 2017.

REFERENCES

1. P.S.Bimbhra, "Electrical Machinery", Khanna Publication Pvt. Ltd, Second Edition, 2021.
2. B.R.Gupta, "Fundamental of Electric Machines", New age International Publishers, Third Edition Reprint, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/108102146 - (DC Machines & Transformers)
2. https://www.classrcentral.com/course - (Electrical Machines)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	-	-	1	-	3	3	1	2
2	3	3	2	-	2	-	-	-	-	1	-	3	3	1	2
3	3	3	2	-	2	-	-	-	-	1	-	3	3	1	2
4	3	3	2	-	-	-	-	-	-	1	-	3	3	1	2
5	3	3	2	-	-	-	-	-	-	1	-	3	3	1	2
6	3	3	2	2	-	-	-	-	3	3	-	3	3	1	2
AVG	3	3	2	2	2	-	-	-	3	1.3	-	3	3	1	2

1-Low 2-Medium 3-High '-' – No Correlation

23EEE302 **ANALOG ELECTRONICS AND CIRCUITS** **LT P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To understand the structure of basic electronic devices.
- To learn the operation and applications of transistor and thyristors.
- To study the characteristics of amplifier gain and frequency response.
- To understand the basic concepts of multi stage amplifier.
- To learn the required functionality of positive and negative feedback systems.
- To acquire knowledge on operations of semiconductor devices and amplifiers.

UNIT I DIODE AND ITS APPLICATION **9**

PN junction diodes: structure, operation and V-I characteristics - Diffusion and transition capacitance - Clipping & Clamping circuits - Rectifiers: Half Wave and Full Wave Rectifier - Display devices: LED, Laser diodes - Zener diode: structure, operation and V-I characteristics, Reverse characteristics - Zener diode as regulator - MATLAB Simulation on VI Characteristics of Diode.

UNIT II TRANSISTORS AND FET **9**

BJT, JFET and UJT - structure, operation, characteristics and Biasing, Simulation on Characteristics of BJT.

UNIT III AMPLIFIERS **9**

BJT small signal model - Analysis of CE, CB, CC amplifiers- Gain and frequency response - MOSFET small signal model - Analysis of CS and Source follower - Gain and frequency response - High frequency analysis , Introduction to power amplifier (qualitative treatment only).

UNIT IV DIFFERENTIAL AMPLIFIER AND SWITCHING CIRCUITS **9**

BIMOS cascade amplifier, Differential amplifier - Common mode and Difference mode analysis - Switching circuits; Multivibrators; Astable, Monostable, Bistable Multivibrator - Schmitt Trigger.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS **9**

Advantages of negative feedback - Voltage / Current, Series, Shunt feedback - Positive feedback - Oscillators: RC phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.

LIST OF EXPERIMENTS

1. Characteristics of PN junction diode and Zener diode.
2. Design and Verification of Diode Clipper and Clampers.
3. Single Phase half-wave and full wave rectifiers with capacitive filters.
4. Characteristics of a NPN Transistor under CE, CB and CC configurations.
5. Characteristics of JFET and UJT.
6. Characteristics of photo diode & photo transistor
7. Design and testing of RC phase shift and LC oscillators.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Develop the structure and working operation of basic electronic devices.
- Analyze the structure and characteristics of transistor and thyristors.
- Discuss the performance of various configurations based amplifier and switching circuits.
- Analyze the characteristics of MOS based cascade and differential amplifier.
- Describe the different types of oscillators.
- Develop and analyze the characteristics of practical electronics circuits.

TEXT BOOKS

1. David A. Bell, “Electronic Devices and Circuits", Oxford University higher education, Fifth Edition, 2018.
2. S.Salivahanan, N.Sureshkumar, “Electronic devices and circuits”, McGraw Hill Education, Fifth Edition, 2022.

REFERENCES

1. Thomas L.Floyd, "Electronic devices", Conventional current version, Pearson prentice hall, Tenth Edition, 2021.
2. V.K.Mehta, Rohit Mehta, "Principles of Electronics", S.Chand Publishing, Twelfth Edition, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/108/102/108102095/ - (Analog Electronic Circuits)
2. https://nptel.ac.in/courses/108/102/108102097/-(Introduction to Electronic Circuits)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	2	-	-	-	-	2	-	3	3	1	2
2	3	3	2	-	2	-	-	-	-	2	-	3	3	1	2
3	3	3	2	-	-	-	-	-	-	2	-	3	3	1	2
4	3	3	2	-	-	-	-	-	-	2	-	3	3	1	2
5	3	3	2	-	-	-	-	-	-	2	-	3	3	1	2
6	3	3	2	-	-	-	-	-	3	3	-	3	3	1	2
AVG	3	3	2	-	2	-	-	-	3	2.2	-	3	3	1	2

1-Low 2-Medium 3-High '-' – No Correlation

23EEE303 DIGITAL ELECTRONICS AND LINEAR INTEGRATED CIRCUITS LT P C
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To study various number systems and basic theorems of boolean algebra and gate level minimization and implementation.
- To understand the design of various combinational digital circuits using logic gates.
- To study the analysis and design procedures for synchronous Sequential circuits.
- To learn linear and non linear applications of operational amplifiers.
- To know the internal functional blocks and the applications of Application ICs.
- To acquire knowledge on design, testing and characterizing of circuit behavior with digital ICs and Analog ICs.

UNIT I NUMBER SYSTEMS AND BOOLEAN ALGEBRA 9

Review of number systems, Types and conversion, Binary codes - Error detection and correction codes (Parity and Hamming code). Boolean theorems and properties - DeMorgan's theorem, SOP and POS forms - Logic gates - Switching functions and minimization using K-maps - Simulation of logic gates using MATLAB.

UNIT II COMBINATIONAL CIRCUITS AND PROGRAMMBLE LOGIC DEVICES 9

Design of adders, subtractors - Multiplexers and Demultiplexers - Magnitude comparator - Code Converters - Encoders and Decoders - Introduction to Programmable Logic Devices: PROM, PLA, PAL, CPLD, FPGA - Simulation of Adder and Subtractor using MATLAB.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops - Level triggering and edge triggering - Counters - Asynchronous and synchronous type - Modulo counters - Shift registers - Design of synchronous sequential circuits - Moore and Mealy models - Counters, state diagram; state reduction; state assignment.

UNIT IV OPERATIONAL AMPLIFIER CHARACTERISTICS & APPLICATIONS 9

Introduction to IC - Operational Amplifier: Ideal Op-Amp, DC and AC characteristics, Inverting and Non-inverting Amplifiers - Instrumentation Amplifier - Differentiator and integrator - Sample and Hold circuit - First and second order low pass and high pass active filters - D/A converter (R - 2R ladder and weighted resistor types) - A/D converter (Flash and Successive approximation types).

UNIT V APPLICATION ICs 9

IC voltage regulators: LM78XX, LM79XX fixed series voltage regulator - LM317, LM723 adjustable voltage regulators - Switched mode power supply - IC555 multivibrator - Phase Lock Loop - VCO.

LIST OF EXPERIMENTS

1. Verification of Boolean theorems using digital logic gates.
2. Design and implementation of adder, subtractor and parity generator / checker circuits.
3. Design and implementation of encoder, decoder, multiplexers and demultiplexers.
4. Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types.
5. Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes.
6. Application of Op-Amp: Inverting and non-inverting amplifier, Adder, Subtractor.
7. Application of Op-Amp: Comparator, Integrator and Differentiator.
8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Discuss the electronic circuits involved in the design of logic gates
- Construct the various combinational digital circuits and PLDs
- Analyze and design the synchronous sequential circuits using flip-flops
- Develop the generate waveforms using Op - Amp circuits
- Examine the application of ICs.
- Design and implement circuits with digital ICs like decoders, multiplexers and analog ICs like timers, VCOs

TEXT BOOKS

1. M. Morris Mano, Michael D.Ciletti, “Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog”, Pearson Education, Sixth Edition, 2019.
2. D. Roy Choudhary, Shail B. Jain, “Linear Integrated Circuits”, New Age International Publishers, First Edition, 2021.

REFERENCES

1. A. Anand Kumar, “Fundamentals of Digital Circuits”, PHI Education, Fourth Edition, 2020.
2. S.Salivahanan, V.S.Kanchan Bhaaskaran, “Linear Integrated Circuits”, Tata McGraw Hill Education, Second Edition, 2017.

E-RESOURCES

1. https://archive.nptel.ac.in/courses/117/105/117105080/ - (Digital Systems Design)
2. https://archive.nptel.ac.in/courses/108/108/108108111/ - (Integrated Circuits)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
2	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
3	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
4	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
5	3	3	3	2	2	-	-	1	-	1	-	1	3	2	1
6	3	3	3	3	-	-	-	-	3	3	-	1	3	2	1
AVG	3	3	3	2.2	2	-	-	1	3	1.3	-	1	3	2	1

1-Low 2-Medium 3-High '-' – No Correlation

23EEC301 **PROFESSIONAL DEVELOPMENT** **LT P C**
0 0 2 1

OBJECTIVES

To be proficient in important Microsoft Office tools: MS WORD, EXCEL and POWERPOINT.

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered.
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD: 10 Hours

Create and format a document
Working with tables
Working with Bullets and Lists
Working with styles, shapes, smart art, charts
Inserting objects, charts and importing objects from other office tools
Creating and Using document templates
Inserting equations, symbols and special characters
Working with Table of contents and References, citations
Insert and review comments
Create bookmarks, hyperlinks, endnotes footnote
Viewing document in different modes
Working with document protection and security
Inspect document for accessibility

MS EXCEL: **10 Hours**

Create worksheets, insert and format data

Work with different types of data: text, currency, date, numeric etc.

Split, validate, consolidate and Convert data

Sort and filter data

Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc,)

Work with Lookup and reference formulae

Create and Work with different types of charts

Use pivot tables to summarize and analyze data

Perform data analysis using own formulae and functions

Combine data from multiple worksheets using own formulae and built-in functions to generate results

Export data and sheets to other file formats

Working with macros

Protecting data and Securing the workbook

MS POWERPOINT: **10 Hours**

Select slide templates, layout and themes

Formatting slide content and using bullets and numbering

Insert and format images, smart art, tables, charts

Using Slide master, notes and handout master

Working with animation and transitions

Organize and Group slides

Import or create and use media objects: audio, video, animation

Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to,

- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements.
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding.
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

SEMESTER IV

23EET401 ELECTRICAL POWER TRANSMISSION AND DISTRIBUTION LT P C
3 0 0 3

OBJECTIVES

- To study expressions for the computation of transmission line parameters.
- To learn the equivalent circuits for the transmission lines, based on distance and to determine voltage regulation and efficiency.
- To understand the mechanical design of transmission lines and the types, voltage distribution of insulators.
- To know the types and grading of underground cables.
- To learn about the different distribution systems, types of substations and methods of grounding, EHVAC, HVDC and FACTS.

UNIT I TRANSMISSION LINE PARAMETERS 9

Introduction to power generation - Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - Application of self and mutual GMD: skin and proximity effects - Effects of earth on the capacitance of the transmission line - interference with neighboring communication circuits.

UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Performance of Transmission lines - Short line, medium line and long line - Equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - Transmission efficiency and voltage regulation - Ferranti effect- Formation of Corona - Critical Voltages – Modeling of transmission line using MATLAB .

UNIT III MECHANICAL DESIGN OF LINES AND INSULATORS 9

Mechanical design of OH lines - Line Supports - Types of towers – Tension and Sag Calculation - Effects of Wind and Ice loading- Methods of grounding.
Insulators: Types, voltage distribution in insulator string, improvement of string efficiency- Testing of insulators.

UNIT IV UNDERGROUND CABLES 9

Underground cables - Types of cables - Construction of single core and 3 core cables - Insulation Resistance - Potential Gradient - Capacitance of Single-core and 3 core cables - Grading of cables - Power factor and heating of cables - DC cables

UNIT V DISTRIBUTION SYSTEMS **9**

Distribution Systems - General Aspects - Kelvin‟s Law - AC and DC distributions - Distribution Loss -Types of Substations - Recent Trends in Transmission and Distribution: EHVAC,HVDC and FACTS (Qualitative treatment only) .

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Determine the electrical circuit parameters of transmission lines.
- Explain the performance of short, medium and long transmission lines.
- Describe the sag and tension of transmission lines, string efficiency of insulator.
- Analyze capacitance and grading of under cables.
- Design the appropriate distribution system

TEXT BOOKS

1. V.K.Mehta, Rohit Mehta, “Principles of Power System”, S. Chand & Company Ltd, New Delhi, Revised Edition, 2021
2. C.L.Wadhwa, “Electrical Power Systems”, New Age International Publishers, Seventh Edition, 2016.

REFERENCES

1. A.Chakrabarti, M.L.Soni, P.V.Gupta, R.V.Bhatnagar, “A Text book on Power System Engineering”, Dhanpat Rai & Co (limited), New Delhi, Second Edition, 2016.
2. D.P.Kothari, I.J. Nagarath, “Power System Engineering”, McGraw - Hill Publishing Company limited, New Delhi, Third Edition, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/108/102/108102047/ - (Power system)
2. https://archive.nptel.ac.in/courses/108/105/108105104/-(Power System Engineering)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	-	1	-	1	-	1	-	2	3	-	2
2	3	3	2	2	1	1	-	1	-	1	-	2	3	-	2
3	3	3	2	2	-	1	-	1	-	1	-	2	3	-	2
4	3	3	2	2	-	1	-	1	-	1	-	2	3	-	2
5	3	3	2	2	-	1	-	1	-	1	-	2	3	-	2
AVG	3	3	2	2	1	1	-	1	-	1	-	2	3	-	2

1-Low 2-Medium 3-High '-' – No Correlation

23EET402 **POWER ELECTRONICS** **LT P C**
3 0 0 3

OBJECTIVES

- To learn characteristics of power semiconductor devices and commutation circuit.
- To study and design single phase and three phase controlled converter.
- To learn the design, development and testing of power electronics.
- To understand the basic requirements of industrial power electronics by using the concept of inverters.
- To study the importance of AC-AC converters.

UNIT I OVERVIEW OF POWER ELECTRONICS AND POWER DEVICES 9

Structure, operation and characteristics of SCR, Power transistor, MOSFET,MCT and IGBT - Firing circuit for thyristor - Voltage and Current commutation of thyristor - Gate drive circuit for MOSFET and IGBT - Design of driver and snubber circuit.

UNIT II AC TO DC CONVERTERS 9

2-pulse, 3-pulse and 6-pulse converters - Performance parameters - Effect of source inductance-Gate Circuit Schemes for Phase Control - Dual converters, Applications of controlled rectifiers.

UNIT III DC TO DC CONVERTERS 9

Step-down and step-up chopper - Control strategy - Switched mode regulators - Buck, boost, buck- boost converter, Introduction to Resonant Converters.

UNIT IV DC TO AC CONVERTERS 9

Single phase and three phase voltage source inverters (both 120^0 mode and 180^0 mode) - Voltage & harmonic control - PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multiple PWM - Introduction to space vector modulation –Current source inverter.

UNIT V AC TO AC CONVERTERS 9

Single phase and Three phase AC voltage controllers - Control strategy - Power Factor Control - Multistage sequence control - Single phase and three phase cyclo converters - Introduction to Matrix converters, Applications of cyclo converter.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the knowledge of power electronic devices and converters.
- Describe the performance of converters and power semiconductor devices.
- Analyze the performance of DC-DC converters.
- Discuss the operation of inverter circuits.
- Examine the performance of ac regulator and cycloconverter.

TEXT BOOKS

1. M. H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, New Delhi, PHI Fourth Edition, 2020.
2. P. S. Bimbra "Power Electronics", Khanna Publishers, Sixth Edition, 2018.

REFERENCES

1. Ned Mohan, Tore. M. Underland, William. P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and sons, Fourth Edition, 2021.
2. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, Third Edition, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/108/102/108102145/ - (Power Electronics)
2. https://nptel.ac.in/courses/108/105/108105066/ - (Power Electronics)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	2	1	-	1	-	2	3	-	2
2	3	3	3	3	-	-	-	1	-	1	-	-	3	-	2
3	3	3	3	3	-	-	2	1	-	1	-	-	3	-	2
4	3	3	3	3	-	-	1	1	-	1	-	2	3	-	2
5	3	3	3	3	-	-	1	1	-	1	-	2	3	-	2
AVG	3	3	3	3	-	-	1.6	1	-	1	-	2	3	-	2

1-Low 2-Medium 3-High '-' – No Correlation

23EET403 **CONTROL SYSTEM ENGINEERING** **LT P C**
3 0 2 4

OBJECTIVES

- To learn the transfer function of a given system using mathematical models.
- To know the system performance using time domain analysis
- To understand the knowledge in obtaining the open lop and closed - loop frequency responses of systems.
- To study the stability analysis of given system.
- To learn the various approaches for the state variable analysis.

UNIT I BASIC CONCEPTS AND SYSTEM REPRESENTATION 9

Introduction - Open Loop and Closed Loop Systems - Mathematical Model of Control Systems - Transfer Functions - Mechanical Translational Systems - Mechanical Rotational Systems - Block Diagram - Signal Flow Graph - Synchro's.

UNIT II TIME RESPONSE ANALYSIS 9

Standard Test Signals - Type and Order of Control System - Time Response of First order and Second order System for Unit Step, Unit Ramp and Impulse Input - Time Domain Specifications - Steady State Error and Static Error Constants - P, PI and PID Controllers - Simulation of study of first and second order systems.

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency Response - Frequency Domain Specifications - Resonant Peak - Resonant Frequency - Bandwidth - Cut-off Rate - Gain margin and Phase margin - Frequency response plots - Bode plot - Polar plot - Correlation between time and Frequency response.

UNIT IV STABILITY ANALYSIS 9

Concepts of Stability - Necessary Conditions for Stability - Relative Stability - Routh Hurwitz Stability Criterion - Root Locus - Effect of Addition of Poles - Effect of Addition of Zeros - Nyquist Stability Criterion – MATLAB Simulation on stability analysis.

UNIT V COMPENSATORS AND STATE SPACE ANALYSIS 9

Compensators: Introduction – Types, Lag, Lead and Lag-Lead Design using Bode Plots. State Space Analysis: Concepts of State - State Variables and State phase Model for Linear Time Invariant System - Controllability and Observability.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Construct the various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
- Explain transient and steady state behavior of systems subjected to standard test signals.
- Analyze the various frequency response plots and its systems.
- Develop the concepts of various system stability criterions.
- Design the various compensators and digital control system using state variable models.

TEXT BOOKS

1. I.J.Nagrath and M.Gopal, “Control Systems Engineering”, New Age International (P)Ltd, Publishers, Sixth Edition, 2021.
2. K. Ogata, "Modern Control Engineering", Prentice Hall, Fourth Edition, 2018.

REFERENCES

1. M. Gopal, Control Systems, “Principles and Design”, Tata McGraw Hill, New Delhi, Fourth Edition, 2019.
2. A. Nagoorkani, “Control Systems Engineering”, RBA Publications, Third Edition, 2021.

E-RESOURCES

1. http://www.nptel.ac.in/courses/107/106/107106081-(Introduction of Control Systems)
2. http://www.nptel.ac.in/courses/108/106/108106098-(Introduction of system & control)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	1	-	2	-	-	3	3	3
2	3	3	3	3	3	-	-	1	-	2	-	-	3	3	3
3	3	3	3	3	-	-	-	1	-	2	-	-	3	3	3
4	3	3	3	3	3	-	-	1	-	2	-	-	3	3	3
5	3	3	3	3	-	-	-	1	-	2	-	-	3	3	3
AVG	3	3	3	3	3	-	-	1	-	2	-	-	3	3	3

1-Low 2-Medium 3-High ‘-‘ – No Correlation

23EEE401 **MICROPROCESSOR AND MICROCONTROLLERS** **LT P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To study the hardware architecture and interrupts of 8085
- To learn addressing modes and instruction sets of 8051
- To understand simple applications in development with programming 8051
- To know a prototype using Arduino Uno.
- To understand the function of different blocks of PIC microcontroller
- To study skills in simple program writing in assembly languages.

UNIT I 8085 MICROPROCESSOR **9**

Introduction to Microprocessor - Hardware Architecture of 8085 - Signals - Memory interfacing - I/O ports and data transfer concepts - Timing Diagram - Interrupt structure - Instruction format and Addressing modes - Instruction sets.

UNIT II 8051 MICROCONTROLLER **9**

Hardware Architecture - Pin Description - Memory Organization - Timer - I/O ports - Addressing modes and Instruction sets - Interrupt structure - Simple programming.

UNIT III 8051 PROGRAMMING AND APPLICATIONS **9**

A/D and D/A interfacing - Keyboard and display interface - Temperature control system - Stepper motor control - Washing Machine Control - Simulation of stepper motor control and Traffic light control using MATLAB.

UNIT IV ARDUINO **9**

Introduction to the Arduino - Creating an Arduino programming Environment - Using the Adriana IDE - Creating an Arduino program - Using Libraries - Working with Digital Interfaces - Interfacing with Analog devices - Adding Interrupts - Communicating with devices - Using sensors - Working with Motors - Using an LCD.

UNIT V PIC MICROCONTROLLER **9**

Introduction to PIC Microcontroller - PIC16C6X: Architecture - Data and program memory organization - Addressing modes -Instruction set - Timers - I/O Ports - Interrupt Programming - Speed Control of Induction Motor.

LIST OF EXPERIMENTS

8085 Programs using kits

1. Basic arithmetic and Logical operations.
2. Code conversion, sorting and searching.

Peripherals and Interfacing Experiments

1. Stepper motor control.
2. Key board and Display.
3. A/D and D/A interface and Waveform Generation.

8051 Experiments using kits

1. Basic arithmetic and Logical operations.
2. Displaying a moving/ rolling message in the student arduino trainer kit's output device.
3. Programming PIC architecture with software tools.

TOTAL: 45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Describe the internal operations of 8085 processor.
- Develop skills in writing assembly language programs.
- Analyze and simulate the microcontroller based system.
- Illustrate the prototypes using Arduino with external devices.
- Construct simple programs using PIC microcontroller.
- Design and develop assembly language programs and interfacing of peripheral with microprocessor and microcontroller.

TEXT BOOKS

1. R.S.Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing, Sixth Edition, 2018.
2. Krishna Kant, "Microprocessor and Microcontrollers Architecture, Programming and System design 8085, 8086, 8051, 8096 ", Prentice Hall of India, New Delhi, Third Edition, 2021.

REFERENCES

1. Richard Blum, "Arduino Programming in 24 Hours", Sams Teach Yourself, Second Edition, 2022.
2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey "PIC Microcontroller and Embedded Systems using Assembly and C for PIC18", Pearson Education, Second Edition, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/108/105/108105102/-(Microprocessors & Microcontrollers)
2. https://nptel.ac.in/courses/117/104/117104072/-(Microcontrollers & Applications)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	3	-	-	-	1	-	1	-	3	3	-	3
2	2	1	2	3	-	-	-	1	-	1	-	3	3	-	3
3	2	1	2	3	3	-	-	1	-	1	-	3	3	-	3
4	2	1	2	3	-	-	-	1	-	1	-	3	3	-	3
5	2	1	2	3	-	-	-	1	-	1	-	3	3	-	3
6	2	1	2	3	-	-	-	1	-	1	-	3	3	-	3
AVG	2	1	2	3	3	-	-	1	-	1	-	3	3	-	3

1-Low 2-Medium 3-High '-' – No Correlation

23EEE402 **INDUCTION AND SYNCHRONOUS MACHINES** **LT P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To study the construction, operation and performance of induction machines.
- To understand the starting and speed control of three-phase induction motors.
- To learn the construction, principle of operation and the performance of single phase induction motors and special machines.
- To study and perform the salient and non – salient type synchronous generators.
- To learn the principle of operation and performance of synchronous motor.
- To know about the operating characteristics, losses and efficiency, regulation, speed control of synchronous and induction machines.

UNIT I THREE PHASE INDUCTION MOTOR 9

Constructional details - Types of rotors - Principle of operation - Slip - Cogging and crawling - Equivalent circuit - Torque-Slip characteristics - Condition for maximum torque - Losses and efficiency - Load test - No load and blocked rotor tests - Circle diagram - Separation of losses - Double cage induction motors - Induction generators - Synchronous induction motor - Simulation of circle diagram using MATLAB.

UNIT II STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9

Need for starting - Types of starters - DOL, Rotor resistance, Autotransformer and Star delta starters - Speed control - Voltage control, Frequency control and pole changing - Cascaded Connection - V/f control - Slip power recovery Scheme - Braking of three phase induction motor.

UNIT III SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Constructional details of single phase induction motor - Double field revolving theory and operation - Equivalent circuit - No load and blocked rotor test - Performance analysis - Starting methods of single-phase induction motors - Capacitor-start capacitor run Induction motor - Shaded pole induction motor - Linear induction motor - Repulsion motor - Hysteresis motor – AC series motor- Servo motors- Stepper motors - Universal motor - Introduction to magnetic levitation systems (MAGLEV).

UNIT IV SYNCHRONOUS GENERATOR 9

Constructional details - Types of rotors - winding factors - EMF equation - Synchronous reactance - Armature reaction - Phasor diagrams of non-salient pole synchronous generator connected to infinite bus - Synchronizing and parallel operation - Synchronizing torque - Change of excitation and mechanical input - Voltage regulation - EMF, MMF, ZPF and A.S.A method - steady state power angle characteristics - Two reaction theory - Slip test - short circuit transients - Capability Curves.

UNIT V SYNCHRONOUS MOTOR **9**

Principle of operation - Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power Developed-Hunting – Natural frequency of oscillations – Damper windings - Synchronous condenser - Simulation of Torque equation of synchronous motor using MATLAB.

LIST OF EXPERIMENTS

1. Load test on three-phase Slip ring and Squirrel cage induction motor.
2. No load and blocked rotor tests on three-phase induction motor. (Determination of equivalent circuit parameters).
3. Separation of No-load losses of three-phase induction motor.
4. Load test on single-phase induction motor.
5. No load and blocked rotor test on single-phase induction motor.
6. Regulation of three phase alternator by EMF and MMF methods.
7. Regulation of three phase alternator by ZPF and ASA methods.
8. V and Inverted V curves of Three Phase Synchronous Motor.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze the construction and working principle of different types of 3 phase induction motor.
- Describe the starting and speed control and braking of AC machines.
- Develop the construction and working principle of single phase induction & special machines.
- Illustrate the construction and working principle of synchronous generator.
- Examine the constructional details, starting methods and analyze performance of synchronous motor.
- Verify and predetermine the performance and operating characteristics of induction and synchronous machines.

TEXT BOOKS

1. D.P. Kothari and I.J. Nagrath, “Electric Machines”, McGraw Hill Publishing Company Ltd, Fifth Edition, 2017
2. P.S. Bhimbhra, “Electrical Machinery”, Khanna Publishers, Second Edition, 2021.

REFERENCES

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, “Electric Machines”, Pearson India Education, 2017.
2. B.R.Gupta, “Fundamental of Electric Machines” New age International Publishers, Third Edition, Reprint 2015.

E – RESOURCES

1. https://nptel.ac.in/courses/108/106/108106072/-(Introduction on Induction Machines)
2. https://archive.nptel.ac.in/courses/108/105/108105131/-(Electrical machines II)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	-	-	-	1	-	2	-	2	3	3	2
2	3	3	2	3	3	-	-	1	-	2	-	2	3	3	2
3	3	3	2	3	3	-	-	1	-	2	-	2	3	3	2
4	3	3	2	3	-	-	-	1	-	2	-	2	3	3	2
5	3	3	1	1	-	-	-	1	-	2	-	2	3	3	2
6	3	3	1	1	-	-	-	1	3	2	-	2	3	3	2
AVG	3	3	1.6	2.3	3	-	-	1	3	2	-	2	3	3	2

1-Low 2-Medium 3-High ‘-‘ – No Correlation

23GEE302 PROBLEM SOLVING AND PYTHON PROGRAMMING LT P C
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To understand the basics of algorithmic problem solving.
- To learn the data types, expressions and the statements in python.
- To study the Python functions and function calls to solve problems.
- To learn Python data structures-lists, tuples, dictionaries to represent complex data.
- To understand the modules and python Packages.
- To practice various computational operations and develop solutions using python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing - Identification of Computational Problems - Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation

UNIT V FILES, MODULES, PACKAGES & DATA VISUALIZATION 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative

programs: word count, copy file - Importing Matplotlib - Line plots - Scatter plots - visualizing errors - density and contour plots - Histograms.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time /technical applications using Lists, Tuples. (Items present in a library / Components of a car/ Materials required for construction of a building – operations of list & tuples)
5. Implementing real-time / technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time / technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time / technicall applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)

TOTAL : 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Develop algorithmic solutions to simple computational problems.
- Develop Python programs using expressions to solve the problem.
- Deploy functions and function calls to decompose python programs.
- Implement solutions using compound data in Python lists, tuples, dictionaries.
- Utilize file modules and python packages for developing applications.
- Implement python programs for solving various computational problems.

TEXTBOOKS

1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, O’Reilly Publishers, Second Edition, 2019.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, BCS Learning & Development Limited, First Edition, 2017.

REFERENCES

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, First Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, Notion Press, First Edition, 2021.

E – RESOURCES

1. https://nptel.ac.in/courses/106104074 - (Introduction to Algorithms)
2. https://archive.nptel.ac.in/courses/106/106/106106182/ - (Joy of Computing)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	2	2	-	-	2	-	-	-	-	-	1	-	2	-	-
AVG	2.3	2.5	1.5	1.8	1.8	-	-	-	-	-	1.5	0.7	2.7	0.5	-

1-Low 2-Medium 3-High ‘-‘ – No Correlation

SEMESTER V

23EET501	POWER SYSTEM ANALYSIS	LT P C 3 1 0 4

OBJECTIVES

- To understand the power system under steady state operating condition.
- To learn power flow problem by iterative techniques.
- To study various type of short circuits.
- To know different type of unsymmetrical fault.
- To learn the power system stability analysis.

UNIT I POWER SYSTEM 9+3

Need for system planning and operational studies - Power scenario in India - Power system components - Representation - Single line diagram - Per unit quantities - Per unit impedance diagram - Per unit reactance diagram.

UNIT II POWER FLOW ANALYSIS 9+3

Formation of bus admittance matrix of large power network - Bus classification - Formulation of power flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of voltage controlled buses - Power flow solution by newton raphson method.

UNIT III SYMMETRICAL FAULT ANALYSIS 9+3

Assumptions in short circuit analysis - Formation of impedance bus - Symmetrical short circuit analysis using thevenin‟s theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS 9+3

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - Unsymmetrical fault occurring at any point in a power system - Computation of post fault currents in symmetrical component and phasor domains.

UNIT V STABILITY ANALYSIS 9+3

Classification of power system stability - Rotor angle stability - Swing equation - Swing curve - Power angle equation - Equal area criterion - Critical clearing angle and time - Classical step -by-step solution of the swing equation - Modified Euler method.

TOTAL : 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Discuss the basics of the per unit system.
- Apply the concept of iterative techniques for power flow analysis.
- Analyze the various types of short circuit studies on power system.
- Describe the knowledge on unsymmetrical fault analysis.
- Analyze the types of stability problems in power system.

TEXT BOOKS

1. Kothari.D.P. and Nagrath.I.J., R K Saket , "Modern Power System Analysis", McGraw Hill Education Pvt. Ltd., New Delhi, Fifth Edition, 2022.
2. John J. Grainger, William D. Stevenson, JR, "Power System Analysis", McGraw Hill Education Pvt. Ltd., New Delhi, First Edition, 2018.

REFERENCES

1. Hadi Saadat, "Power System Analysis", McGraw Hill Education Pvt. Ltd., New Delhi, Third Edition, 2019.
2. Kundur P, "Power System Stability and Control", McGraw Hill Education Pvt. Ltd., New Delhi, Tenth reprint, 2018.

E-RESOURCES

1. https:// nptel.ac.in/courses/117/105/117105140/ - (Power System Analysis).
2. https:// nptel.ac.in/courses/108/104/108104051/ - (Power System Analysis).

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	2	-	-	-	-	2	3	-	3
2	3	3	3	3	3	1	3	-	-	-	-	2	3	-	3
3	3	3	3	3	2	1	2	-	-	-	-	2	3	-	3
4	3	3	3	3	2	1	2	-	-	-	-	2	3	-	3
5	3	3	3	3	2	1	2	-	-	-	-	2	3	-	3
AVG	3	3	3	3	2.2	1	2.2	-	-	-	-	2	3	-	3

1-Low 2-Medium 3-High '-' – No Correlation

23EEE501	ELECTRICAL DRIVES (Lab Embedded Theory Course)	LT P C 3 0 2 4

OBJECTIVES

- To learn steady state operation and transient dynamics of a motor load system.
- To study the operation of the converter / chopper fed dc drive.
- To understand the operation and performance of AC Induction motor drives.
- To understand the operation and performance of AC Synchronous motor drives.
- To study and design the current and speed controllers for a closed loop solid state DC motor drives.
- To know process in simulating and controlling various electrical drive system.

UNIT I DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

Steady state analysis of the single and three phase converter fed separately excited DC motor drive – continuous and discontinuous conduction – Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive.

UNIT III INDUCTION MOTOR DRIVES 9

Stator voltage control – energy efficient drive – v/f control – constant air gap flux – field weakening mode – voltage / current fed inverter – closed loop control,

UNIT IV SYNCHRONOUS MOTOR DRIVES 9

V/f control and self-control of synchronous motor: Margin angle control and power factor control – permanent magnet synchronous motor.

UNIT V DESIGN OF CONTROLLERS FOR DRIVES 9

Transfer function for DC motor / load and converter – closed loop control with current and speed feedback – armature voltage control and field weakening mode – design of controllers; current controller and speed controller-converter selection and characteristics.

LIST OF EXPERIMENTS

1. Simulation of converter and chopper fed DC drive.
2. Simulation of closed loop operation of stator voltage control and v/f control of induction motordrive
3. Simulation of synchronous motor drive.
4. PLC based single and three phase inverter.
5. Chopper controlled SED.

6. Speed control of BLDC motor.
7. Transfer function of SED.
8. Stability analysis of linear system.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Illustrate the basic requirements of motor selection for different load profiles.
- Analyze the steady state behavior and stability aspects of drive systems.
- Analyze the dynamic performance of DC drive using converter and chopper control.
- Discuss the knowledge to simulate the AC drive.
- Design the controller for electrical drives.
- Describe the process in simulating and controlling various electrical drive system

TEXT BOOKS

1. Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, Third Edition, 2016.
2. Bimal K. Bose. "Modern Power Electronics and AC Drives", Pearson Education, Second Edition, 2015.

REFERENCES

1. S.K.Pillai, "A First course on Electrical Drives", Wiley Eastern Limited, Fourth Edition 2022.
2. Mohammed A. El-Sharkawi, "Fundamentals of Electrical Drives", Prentice hall of India, Third Edition, 2018.

E-RESOURCES

1. https://nptel.ac.in/courses/108/106/108106072/ - (AC Drives)
2. https://archive.nptel.ac.in/courses/108/105/108105131/ - (Electric motor Drives)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
AVG	2.3	2.5	1.5	1.8	1.8	-	-	-	-	-	1.5	0.7	2.7	0.5	-

1-Low 2-Medium 3-High '-' – No Correlation

23EEE502 RENEWABLE ENERGY AND ENERGY STORAGE SYSTEM LT P C
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

- To know about renewable energy sources and technologies.
- To learn the fundamental concepts about wind energy systems and solar energy.
- To know concepts of various energy sources.
- To study the different energy storage system.
- To understand the Battery Management modeling.
- To understand various renewable energy sources and battery.

UNIT I RENEWABLE ENERGY SOURCES 9

Environmental consequences of fossil fuel use - Importance of Renewable Sources (RE) of energy - Sustainable design and development - Types of RE sources - Limitations of RE sources - Present Indian and international energy scenario of conventional and RE sources.

UNIT II WIND AND SOLAR ENERGY 9

Power in the wind - Types of wind power plants(wpps) - Components of wpps - Working of wpps - Grid integration issues of wpps. Solar radiation - Radiation measurement - Solar ponds - Solar photovoltaic systems - Basic principle of spv conversion - Types of pv systems - Maximum power point tracking - Best free solar pv system simulation.

UNIT III OTHER ENERGY SOURCES 9

Introduction - Bio mass resources - Conversion processes - Biomass cogeneration - Environmental benefits - Geothermal energy - Geothermal electricity - Tidal energy - Energy from the tides - Barrage and non barrage tidal power systems - Wave energy .

UNIT IV ENERGY STORAGE SYSTEM 9

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zinc Chloride battery; Ultra capacitors; Hydrogen – Fuel cell.

UNIT V BATTERY MODELLING AND BMS 9

General approach to modelling batteries, Parameterization of the NiCd battery model, Simulation examples. Selection of battery for EVs & HEVs, Traction Battery Pack design, SOC Estimation, Energy & Power estimation, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests

LIST OF EXPERIMENTS

1. Simulation study on solar PV energy system and wind energy generator.
2. Experiment on VI-characteristics and efficiency of 1kWp solar PV system.
3. Test on shadowing effect & diode based solution in 1kWp solar PV system.
4. Experiment on performance assessment of micro wind energy generator.
5. Simulation study on hybrid (solar-wind) power system.
6. Simulate the battery pack
7. Simulate the Battery Management System

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able:

- Examine various renewable sources.
- Discuss the significance of solar energy and importance of wind energy.
- Analyze the various energy sources.
- Develop the knowledge in energy storage system and usage in modern world.
- Discuss the methods of battery modeling systems.
- Design and simulate the performance analysis the various renewable energy sources and battery.

TEXT BOOKS:

1. Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, “Fundamentals and Applications of Renewable Energy”, Indian Edition, McGraw Hill, First Edition, 2020.
2. Satyender Singh, “Energy Storage Systems: An Introduction Hardcover”, Nova Science Publishers, First Edition, 2021 .

REFERENCES

1. D.P.Kothari, K.C.Singal , Rakesh Ranjan , “Renewable Energy Sources And Emerging Technologies”, McGraw hill, Third Edition, 2022.
2. Davide Andrea, “Battery Management Systems for Large Lithium-Ion Battery Packs”, ARTECH House, 2018.

E-RESOURCES

1. https://onlinecourses.nptel.ac.in/noc22_ch27/preview - (Renewable Energy Systems)
2. https://nptel.ac.in/courses/113105102 - (Electrochemical Energy Storage System)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	2	-	2	2	1	-	-	-	2	3	-	3
2	3	3	-	2	-	2	2	1	-	-	-	2	3	-	3
3	3	3	-	2	-	2	2	1	-	-	-	2	3	-	3
4	3	3	-	2	-	2	2	1	-	-	-	2	3	-	3
5	3	3	-	2	-	2	2	1	-	-	-	2	3	-	3
6	3	3	-	2	2	2	2	1	2	2	-	2	3	2	3
AVG	3	3	-	2	2	2	2	1	2	2	-	2	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation

PROFESSIONAL ELECTIVE – I

23EEP501 **UNDER GROUND CABLE** **LT P C**
3 0 0 3

OBJECTIVES

- To understand Power Cable Characteristics and Applications.
- To learn the cable architecture and characteristics.
- To know about underground power cables supply systems
- To study underground cable System Fault Locating.
- To learn about test and maintenance of Underground cable system.

UNIT I INTRODUCTION TO ELECTRICAL POWER CABLE 9

Development of Underground Cables - Electric Lighting- Distribution of Energy for Lighting- - Paper Insulated Cables - Underground Residential Distribution Systems- Underground Residential Distribution Systems- Medium Voltage Cable Development.

UNIT II CABLE ARCHITECHTURE, DIELECTRIC THEORY AND CABLE CHARACTERISTICS 9

Architecture of Underground Cabling System - Basic Dielectric Theory of Cable —Conductors -Armour and Protective Finishes - Cable Characteristics: Electrical- Fundamentals of Electrical Insulation Materials - Electrical Properties of Cable Insulating Materials - Cable Standards and Quality Assurance - Cable design parameters- Current Carrying Capacity - Short-circuit Ratings.

UNIT III SUPPLY DISTRIBUTION SYSTEMS AND CABLES 9

Supply Distribution Systems - Distribution Cable Types, Design and Applications - Paper Insulated Distribution Cables - PVC Insulated Cables - Polymeric Insulated Distribution Cables for 6-30 kV - Manufacture of Distribution Cables - Joints and Terminations for Distribution Cables - Testing of Distribution Cables.

UNIT IV TRANSMISSION SYSTEMS AND CABLES 9

Basic Cable Types for A.C. Transmission - Self-contained Fluid-filled Cables - Gas Pressure Cables - High Pressure Fluid-filled Pipe Cables - Polymeric Insulated Cables for Transmission Voltages - Techniques for Increasing Current Carrying Capacity -Transmission Cable Accessories and Jointing for Pressure-assisted and PolymerCables.

UNIT V CABLE INSTALLATION, TESTING, MAINTENANCE 9

Installation of Transmission Cables -Splicing, Terminating, and Accessories - Sheath Bonding and Grounding-Testing of Transmission Cable Systems - Underground System Fault locating - Field Assessment of Power Cable Systems- Condition monitoring tests – PD measurements.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Design the fundamental of underground cable system.
- Apply knowledge on the architecture of UG cable and physical and electrical characteristics of the UG cable.
- Develop the different types of cable used in distribution system.
- Analyze on underground cables used in transmission system
- Describe the theory/methodology of cable fault detection and rectification, testing and maintenance.

TEXTBOOKS

1. William Thue, "Electrical Power Cable Engineering", CRC Press Taylor & Francis Group., 6000 Broken Sound Parkway NW, Suite 300 Boca Raton, FL 33487-2742, Third Edition, 2022.
2. G. F. Moore, "Electric Cables Handbook" , Blackwell Science Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK., Third Edition, 2017.

REFERENCES

1. Leonard L. Grigs by, "Electrical Power Cable Engineering" – CRC Press, Marcel Dekker, Third Edition 2021.
2. Christian Flytkjaer Jensen, "Online Location of Faults on AC Cables in Underground Transmission Systems" (Springer Theses), 2018.

E-RESOURCES

1. https:// nptel.ac.in/courses/117/105/117105140/ - (Power System)
2. https://archievenptel.ac.in/courses/108/102/108102047/ - (Generation, Transmission and Distribution)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
3	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
4	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
5	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
AVG	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

23EEP502 **POWER QUALITY** **LT P C**
3 0 0 3

OBJECTIVES

- To learn the basic definitions in power quality.
- To study on production of voltages sags, over voltages
- To understand the principles of harmonics problems.
- To know the sources and effect of harmonics in power system.
- To know DSTATCOM and various methods of power quality monitoring.

UNIT I INTRODUCTION TO POWER QUALITY 9

Terms and definitions & Sources-Overloading, under voltage, over voltage-Concepts of transients Short duration variations such as interruption-Long duration variation such as sustained interruption Sags and swells -Voltage sag- Voltage swell - Voltage imbalance - Voltage fluctuations-Power frequency variations International standards of power quality-Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II VOLTAGE SAG AND SWELL 9

Estimating voltage sag performance-Thevenin's equivalent source-Analysis and calculation of various fault condition –Estimation of the sag severity Mitigation of voltage sag, Static transfer switches and fast transfer switches - Capacitor switching - Lightning - Ferro resonance-Mitigation of voltage swell An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT III HARMONICS 9

Harmonic sources from commercial and industrial loads - Locating harmonic sources -Power system response characteristics - Harmonics Vs transients - Effect of harmonics - Harmonic distortion Voltage and current distortions - Harmonic indices - Inter harmonics - Resonance Harmonic distortion evaluation IEEE and IEC standards.

UNIT IV PASSIVE POWER COMPENSATORS 9

Principle of Operation of Passive Shunt and Series Compensators Analysis and Design of Passive Shunt Compensators -Simulation and Performance of Passive Power Filters – Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and Its Mitigation-Fundamentals of load compensation Voltage regulation & power factor correction.

UNIT V POWER QUALITY MONITORING & CUSTOM POWER DEVICE 9

Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems Quality measurement equipment - Harmonic / spectrum analyzer - Flicker meters Disturbance analyzer Applications of expert systems for power quality monitoring -Principle& working of DSTATCOM in Voltage control mode, current control mode

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to

- Describe various sources, causes and effects of power quality issues.
- Apply the concept of voltage sag and swell.
- Analyze the concepts about Voltage and current distortions, harmonics.
- Summarize the passive filters and compensation techniques.
- Develop knowledge on power quality monitoring

TEXT BOOKS

1. Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H. Wayne Beaty, "Electrical Power Systems Quality", McGraw Hill, Third Edition , 2022.
2. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "Power Quality Problems & Mitigation Techniques" Wiley, 2019.

REFERENCES

1. G.T.Heydt, "Electric Power Quality", West Lafayette, IN, Stars in a Circle Publications, Second Edition, 2021.
2. M.H.J Bollen, "Understanding Power Quality Problems:Voltage Sag and Interruptions", New York: IEEE Press, Second Edition, 2019.

E-RESOURCES

1. https://archieve.nptel.ac.in/courses/108/106/108106025/-(Power Quality in Power Distribution System).
2. https://archieve.nptel.ac.in/courses/108/107/108107157/-(Power Quality Improvement Techniques).

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	3	3	-	3	-	3	3	3	3
2	3	3	3	3	2	-	3	3	-	3	-	3	3	3	3
3	3	3	3	3	2	-	3	3	-	3	-	3	3	3	3
4	3	3	3	3	2	-	3	3	-	3	-	3	3	3	3
5	3	3	3	3	2	-	3	3	-	3	-	3	3	3	3
AVG	3	3	3	3	2	-	3	3	-	3	-	3	3	3	3

1-Low 2-Medium 3-High '-' – No Correlation.

23EEP503 FLEXIBLE AC TRANSMISSION SYSTEMS LT P C
3 0 0 3

OBJECTIVES

- To study the active power control techniques.
- To learn the static VAR compensators and their applications.
- To understand the thyristor controlled series capacitors.
- To know the operation on STATCOM devices.
- To understand the basics of advanced FACTS controllers.

UNIT I INTRODUCTION 9

Real and reactive power control in electrical power transmission lines - Loads & system compensation Uncompensated transmission line Shunt and series compensation.

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

Voltage control by SVC - Advantages of slope in dynamic characteristics - Influence of SVC on system voltage - Design of SVC voltage regulator - TCR-FC TCR modeling of SVC for power flow and fast transient stability - Applications: Enhancement of transient stability - Steady state power transferEnhancement of power system damping.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR AND APPLICATIONS 9

Operation of the TCSC - Different modes of operation - Modeling of TCSC - Variability reactance model Modelling for power flow and stability studies - Applications: Improvementof the system stability limit Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM) - Principle of operation - V-I characteristics Applications: Steady state power transfer - Enhancement of transient stability - Prevention of voltage instability - SSSC Operation of SSSC and the control of power flow Modeling of SSSC in load flow and transient stability studies Dynamic voltage restorer (DVR).

UNIT V ADVANCED CONTROLLERS 9

Interline DVR (IDVR) - Unified power flow controller (UPFC) - Interline power flow controller (IPFC) Unified power quality conditioner (UPQC).

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TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze hunt and series compensation.
- Design the static VAR compensate or regulator.
- Summarize the thyristor controller series capacitor.
- Analyze the performance of steady state and transients of FACTS controllers.
- Apply the advanced FACTS controllers in power system.

TEXTBOOKS

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor-Based FACTS Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Third Edition, 2023.
2. Narain G.Hingorani, "Understanding FACTS - Concepts and Technology of Flexible AC Transmission Systems", Wiley India Private Limited, Third Edition, 2021.

REFERENCES

1. K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Third Edition, 2021.
2. Bjarne R.Anderson, "Flexible A.C. Transmission Systems", Springer, First Edition, 2020.

E-RESOURCES

1. https://www.infocobuild.com/education/audio - (FACTS Devices)
2. https://nptel.ac.in/courses/108/107/108107114/-(FACTSDevices)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
2	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
3	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
4	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
5	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3
AVG	3	3	3	2	2	-	2	1	-	1	-	2	3	2	3

1- Low 2- Medium 3-High '-' – No Correlation.

23EEP504 **HIGH VOLTAGE ENGINEERING** **LT P C**
3 0 0 3

OBJECTIVES

- To study various types of over voltages in power system and protection methods.
- To learn nature of Break down mechanism in solid, liquid and gaseous dielectrics.
- To know the effects of over voltages in power systems.
- To study the different technique of measuring over voltage.
- To learn about the test of power apparatus in high voltage system.

UNIT I OVER VOLTAGE SINEL ECTRICAL POWER SYSTEMS 9

Causes of over voltages and its effects on power system – Lightning mechanism, energy in lightning – Switching surges and temporary over voltages – Corona and its effects – Bewley lattice diagram- Protection against over voltages.

UNIT II DIELECTRIC BREAKDOWN 9

Properties of Dielectric materials – Gaseous breakdown in uniform and non-uniform fields - Corona discharges - Vacuum breakdown Conduction and breakdown in pure and commercial liquids – Maintenance of oil Quality Breakdown mechanisms in solid and composite dielectrics – Applications of insulating materials in electrical equipment.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC voltage: Rectifiers, voltage multipliers, vandigraff generator Generation of high impulse voltage: single and multistage Marx circuits - Generation of nonstandard impulse voltage and very fast transients voltage (VFTO) Generation of high AC voltages: cascaded transformers, resonant transformer and tesla coil - Generation of switching surges-Generation of impulse currents Triggering and control of impulse generators.

UNIT IV MEASUREMENT OFHIGH VOLTAGES AND HIGH CURRENTS 9

High Resistance with series ammeter - Dividers, Resistance, Capacitance and Mixed dividers Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters Sphere Gaps - High current shunts Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

High voltage testing of electrical power apparatus as per International and Indian standards - Power frequency, impulse voltage and DC testing of Insulators - Circuit breakers - Bushing, isolators and transformers Insulation Coordination & testing of cable.

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TOTAL : 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze the various overvoltage's and its effects on power systems
- Describe breakdown phenomena in different medium under uniform and non-uniform fields.
- Design the high voltage and current
- Analyze the measuring High DC, AC, Impulse voltage and currents.
- Discuss suitable HV testing of Electrical power apparatus as per Standards.

TEXTBOOKS

1. S.Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education Pvt.Ltd., New Delhi, Sixth Edition, 2020.
2. Ravindra roar and H. C. Wolfgang Mosch, "High voltage Insulation Engineering", New Age International Publishers, First Edition, 2022.

REFERENCES

1. W. Auguesteen and K.R Vadivelu, "Principles of High Voltage Engineering", Notion Publishers, First Edition, 2019.
2. C. L. Wadhwa, "High voltage Engineering", New Age International Publishers, Fourth Edition, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/108/104/108104048/- (High Voltage Engineering)
2. https://nptel.ac.in/courses/108/104/108104013/- (High Voltage DC Transmission)

Mapping of Cos-Pos & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	2	-	1	-	2	-	3	3	2	2
2	3	2	2	2	-	2	-	1	-	2	-	3	3	2	2
3	3	2	2	2	-	2	-	1	-	2	-	3	3	2	2
4	3	2	2	2	-	2	-	1	-	2	-	3	3	2	2
5	3	2	2	2	-	2	-	1	-	2	-	3	3	2	2
Avg.	3	2	2	2	-	2	-	1	-	2	-	3	3	2	2

1-Low 2-Medium 3-High '-' – No Correlation.

23EEP505 UTILIZATION OF ELECTRICAL ENERGY LT P C
3 0 0 3

OBJECTIVES

- To understand the traction system considering economic and technology
- To learn the energy saving concept by different ways of illumination.
- To study the different types of heating and welding techniques.
- To know the refrigeration and air-conditioning systems.
- To learn the knowledge in UPS, house wiring and earthing.

UNIT I TRACTION 9

Merits of electric traction - Requirements of electric traction system - Systems of railway electrification Mechanics of train movement and energy consumption - Traction motors and control Track equipment and collection gear - Electric braking - Recent trends in electric traction - Introduction to EMU and metro railways.

UNIT II ILLUMINATION 9

Importance of lighting - Properties of good lighting scheme Important terms used in illumination engineering - Laws of illumination - Polar curves - Photometry - Types of lamps - Lighting calculations Design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting Energy efficient lamps.

UNIT III HEATING AND WELDING 9

Introduction – Advantages of electric heating – Modes of heat transfer Resistance, Arc ,Induction, Dielectric, Infrared, Microwave and Solar heating - Brief introduction to electric welding Resistance, Arc and Radiation welding - Welding generator, welding transformer and the characteristics Introduction to TIG, MIG Welding.

UNIT IV REFRIGERATION AND AIR CONDITIONING 9

Refrigeration – Domestic refrigerator and water coolers - Air-Conditioning Various types of air-conditioning system and their applications - Smart air conditioning units Energy Efficient motors: Standard motor efficiency – Need for efficient motors – Motor life cycle - Direct Savings and payback analysis Efficiency evaluation factor.

UNIT V DOMESTIC UTILIZATION OF ELECTRICAL ENERGY 9

Domestic utilization of electrical energy: House wiring, Induction based appliances, Online and OFF line UPS, Batteries - Power quality aspects - Nonlinear and domestic loads – Earthing Domestic, Industrial and Substation Introduction to E-Vehicle (Qualitative treatment only).

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze the appropriate type of electric supply system as well as to evaluate the performance of a traction unit
- Summarize the lighting system using LED Technologies
- Apply the knowledge on method of heating for any particular industrial application
- Design an electric connection for any domestic appliance like refrigerator andair conditioner
- Design a battery charging circuit for a specific house hold application

TEXTBOOKS

1. Wadhwa.C.L, "Generation, Distribution and Utilization of Electrical Energy", NewAge International Pvt. Ltd, Fourth Edition, 2021.
2. Gupta.J.B, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, Third Edition, 2016.

REFERENCES

1. R.K.Rajput, "Utilisation of Electric Power including electric drives and traction", Laxmi Publications, Third Edition, 2018.
2. Dr.Uppal S.L. and Prof.S.Rao, "Electrical Power Systems", Khanna Publishers, New Delhi, Sixteenth Edition, 2022.

E-RESOURCES

1. https://nptel.ac.in/courses/108/105/108105060/-(Illumination Engineering).
2. https://nptel.ac.in/courses/112/105/112105129/- (Refrigeration and Air conditioning).

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	1	-	1	-	2	-	2	3	2	2
2	3	2	2	2	-	1	-	1	-	2	-	2	3	2	2
3	3	2	2	2	-	1	-	1	-	2	-	2	3	2	2
4	3	2	2	2	-	1	-	1	-	2	-	2	3	2	2
5	3	2	2	2	-	1	-	1	-	2	-	2	3	2	2
AVG	3	2	2	2	-	1	-	1	-	2	-	2	3	2	2

1-Low 2-Medium 3-High '-' – No Correlation.

23EEP506 **SMART GRID** **LT P C**
3 0 0 3

OBJECTIVES

- To understand the concepts of Smart Grid and its present developments.
- To know the concepts of substation automation and wide area monitoring system.
- To study the distributed generation and smart consumption in smart grid.
- To learn the advanced metering infrastructure in real time scenario.
- To know the regulations and market models for smart grid.

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of electric Grid - Concept definitions - Need for smart grid Difference between Conventional grid and smart grid - Opportunities & Barriers of Smart Grid - Functions and benefits Present development and international policies in smart grid.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers - Smart energy resources Smart Sensors, Smart storage, SMES - Smart substations–Home & building automation - Substation automation - Feeder automation Transmission systems: EMS - FACTS and HVDC - Wide area monitoring - Protection and control Distribution systems: DMS - Volt/VAR control - Fault Detection - Isolation and Service restoration- Outage management High-Efficiency distribution transformers - Phase shifting transformers Plug in Hybrid Electric Vehicles(PHEV).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to smart meters - Advanced metering infrastructure (AMI) drivers and benefits - AMI protocols standards and initiatives - AMI needs in the smart grid - Phasor measurement Unit (PMU) Intelligent electronic devices (IED) & their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power quality & EMC in smart grid Power quality issues of grid connected renewable energy sources – Power quality conditioners for smart grid - Web based power quality monitoring Power quality audit – Concept of micro grid - Need & applications of micro grid - Formation of micro grid - Protection & control of micro grid.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local area network (LAN) - House area network (HAN) - Wide area network (WAN) Broad band over power line (BPL) - IP based protocols - Basics of web service and cloud computing to make smart grids smarter Cyber security for smart grid.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Develop more understanding on the concepts of Smart Grid and its present developments.
- Analyze about the different Smart Grid technologies.
- Describe about different smart meters and advanced metering infrastructure.
- Analyze the power quality management in Smart Grids.
- Develop on LAN, WAN and Cloud Computing for Smart Grid applications.

TEXTBOOKS

1. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, Second Edition, 2020.
2. Janaka Ekanayake, NickJenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley, Second Edition, 2021.

REFERENCES

1. K S Manoj, "Smart Grid: Concepts to Design", Notion Press; First Edition, 2019.
2. Jhal S, "Smart Grid Fundamentals & Applications", New Age International Publishers; First Edition, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/108/107/108107113/- (Introduction to smart grid)
2. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee42/- (smart grid applications)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
1	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
2	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
3	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
4	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
5	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
Avg	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-

1-Low 2-Medium 3-High '-' – No Correlation.

PROFESSIONAL ELECTIVE - II

23EEP507 **SMPS AND UPS** **LT P C**
3 0 0 3

OBJECTIVES

- To understand low-power switched-mode power supplies (SMPS).
- To know low-power uninterruptible power supplies (UPS).
- To study modern power electronic converters.
- To learn about the various types of filters.
- To study the applications of UPS, SMPS, power conditioners, converters, and filters in electric power utilities.

UNIT I DC - DC CONVERTERS 9

Principles of step down and step up converters Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters.

UNIT II SWITCHING MODE POWER CONVERTERS 9

Analysis and state space modeling of fly back, Forward, Luo, Half bridge and full bridge converters Control circuits and PWM techniques.

UNIT III RESONANT CONVERTERS 9

Introduction - Classification - Basic concepts - Resonant switch - Load Resonant converters ZVS, Clamped voltage topologies - DC link inverters with Zero Voltage Switching - Series and parallel Resonant inverters Voltage control.

UNIT IV DC - AC CONVERTERS 9

Single phase and three phase inverters - Control using various (sine PWM, SVPWM and advanced modulation) techniques - Various harmonic elimination techniques - Multilevel inverters – Concepts Types: Diode clamped - Flying capacitor - Cascaded types Applications.

UNIT V POWER CONDITIONERS, UPS & FILTERS 9

Introduction - Power line disturbances - Power conditioners - UPS: offline UPS, Online UPS, Applications Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI,current filter, DC filters - Design of inductor and transformer for PE applications, Selection of capacitors.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Design various converters.
- Develop control circuits for converters.
- Design different types of converters.
- Analyze various methodologies in filters.
- Apply a battery charging circuit for a specific household application.

TEXT BOOKS

1. M.H.Rashid, "Power Electronics Handbook", Butterworth-Heinemann, Fifth Edition, 2023.
2. Fang Lin Luo and Fang Lin Luo, "Advanced DC/DC Converters", CRC Press, Third Edition, 2021.

REFERENCES

1. Krein Philip T, "Elements of Power Electronics", Oxford University press, Third Edition, 2022.
2. Agarwal, "Power Electronics: Converters, Applications, and Design", Prentice Hall of India, Fourth Edition, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/108/108/108108036/ - (Switched Mode Power Conversion)
2. https://nptel.ac.in/courses/108/108/108108035/ - (PWM for Power Converters)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	-	2	1	-	2	-	2	3	2	3
2	3	3	3	2	-	-	2	1	-	2	-	2	3	2	3
3	3	3	3	2	-	-	2	1	-	2	-	2	3	2	3
4	3	3	3	2	-	-	2	1	-	2	-	2	3	2	3
5	3	3	3	2	-	-	2	1	-	2	-	2	3	2	3
AVG	3	3	3	2	-	-	2	1	-	2	-	2	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

23EEP508 **SPECIAL ELECTRICAL MACHINES** **LT P C**
3 0 0 3

OBJECTIVES

- To understand the principles of operation, control, and performance of stepping motors.
- To learn the construction, principles of operation, control, and performance of switched reluctance motors.
- To understand the characteristics and applications of permanent magnet brushless D.C. motors.
- To acquire knowledge on the construction, principles of operation, and performance of permanent magnet synchronous motors.
- To learn about the construction of linear induction motors.

UNIT I STEPPER MOTORS **9**

Constructional features - Principle of operation -Types - Torque Equations Modes of excitation - Characteristics - Driver Circuits - Microprocessor control of stepper motors Concept of lead angle Applications.

UNIT II SWITCHED RELUCTANCE MOTORS (SRM) **9**

Constructional features - Principle of operation Torque prediction-Characteristics Steady state performance prediction - Analytical method - Power controllers Methods of rotor position sensing - Control of SRM drive - Sensor less operation of SRM Applications.

UNIT III PERMANENT MAGNET BRUSHLESS D.C. MOTORS **9**

Permanent Magnet materials - Magnetic Characteristics - Types - Principle of operation Magnetic circuit analysis - EMF and Torque equations Power Converter Circuits and their controllers - Characteristics and control Applications.

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) **9**

Constructional features - Principle of operation - Ideal PMSM - EMF and Torque equations Sine wave motor with practical windings - Phasor diagram - Power controllers Performance characteristics - Digital controllers Applications.

UNIT V OTHER SPECIAL MACHINES **9**

Constructional features - Principle of operation and Characteristics of Hysteresis motor – Synchronous Reluctance Motor - Linear Induction motor - Repulsion motor Applications.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Design suitably configured modern electric motors for constrained applications with a thorough understanding of fundamental principles, constructions, and classifications.
- Develop an understanding of special machines used in different applications.
- Analyze the performance characteristics of special electrical machines using suitable equations and phasor diagram techniques.
- Summarize different control techniques of special electrical machines to meet various requirements based on the applications.
- Apply knowledge to outline the characteristics of the synchronous reluctance motor.

TEXT BOOKS

1. T. Kenjo, "Stepping Motors and their Microprocessor Controls", Oxford, Third Edition, 2022.
2. E.G. Janardanan, "Special Electrical Machines" , PHI learning Private Limited, Delhi, Third Edition, 2023.

REFERENCES

1. R. Krishnan, "Switched Reluctance Motor Drives - Modeling, Simulation, Analysis, Design and Application", CRC Press, Second Edition, 2022.
2. K. Venkataratnam, "Special Electrical Machines", Universities Press (India) Private Limited, Second Edition, 2022.

E-RESOURCES

1. https://nptel.ac.in/courses/108/102/108102156/ - (Special Electrical Systems)
2. https://nptel.ac.in/courses/108104011 - (Advanced Electric Drives)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	1	-	1	-	2	-	2	3	3	3
2	3	3	2	2	1	1	-	1	-	2	-	2	3	3	3
3	3	3	2	2	1	1	-	1	-	2	-	2	3	3	3
4	3	3	2	2	1	1	-	1	-	2	-	2	3	3	3
5	3	3	2	2	1	1	-	1	-	2	-	2	3	3	3
AVG	3	3	2	2	1	1	-	1	-	2	-	2	3	3	3

1-Low 2-Medium 3-High '-' – No Correlation.

23EEP509 **MULTI LEVEL POWER CONVERTER** **L T P C**

3 0 0 3

OBJECTIVES

- To learn about multilevel topology with a common DC bus link.
- To study the working of cascaded H-Bridge, diode-clamped, and flying capacitor.
- To know the working of MLIs with a reduced switch count.
- To understand the simulation of three-level diode-clamped MLI and a three-level flying capacitor-based MLI with resistive and reactive loads.
- To learn how to simulate MLIs with a reduced switch count.

UNIT I MULTILEVEL TOPOLOGIES 9

Introduction Generalized Topology with a Common DC bus Converters derived from the generalized topology - symmetric topology without a common DC link - Asymmetric topology.

UNIT II CASCADED H-BRIDGE MULTILEVEL INVERTERS 9

Introduction -H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation. Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level- Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted PWM Schemes- Staircase Modulation.

UNIT III DIODE CLAMPED MULTILEVEL CONVERTER 9

Introduction - Converter structure and Functional Description - Modulation of Multilevel converters - Voltage balance Control - Effectiveness Boundary of voltage balancing in DCMC converters - Performance results.

UNIT IV FLYING CAPACITOR MULTILEVEL CONVERTER 9

Introduction - Flying Capacitor topology - Modulation scheme for the FCMC - Dynamic voltage balance of FCMC.

UNIT V MULTILEVEL CONVERTER WITH REDUCED SWITCH COUNT 9

Multilevel inverter with reduced switch count-structures, working principles and pulse generation methods.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Examine different topologies of multilevel inverters (MLIs) with and without DC link capacitors.
- Describe the working principles of Cascaded H-Bridge MLI, diode-clamped MLI, flying capacitor MLI, and MLI with reduced switch count.
- Analyze the voltage balancing performance in diode-clamped MLI.
- Design the three-level, capacitor-clamped, and diode-clamped MLIs with R and RL loads.
- Develop MLIs with reduced switch configurations using a fundamental switching scheme.

TEXT BOOKS

1. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, Tenth Impression, 2021.
2. Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla, "Multilevel Converters or Industrial Applications", CRC Press, First Edition, 2017.

REFERENCES

1. BinWu, Mehdi Narimani, “High Power Converters and AC drives”, by IEEE press, Second Edition, 2017.
2. Hani Vahedi, Mohamed Trabelsi, Single-DC-Source Multilevel Inverters, Springer, First Edition, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/108102157/ - (High Power Multilevel Converters)
2. https://archive.nptel.ac.in/courses/117/103/117103148/ - (Design of Power Electronic Converters)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	-	-	1	-	2	-	2	3	2	2
2	3	2	2	2	1	-	-	1	-	2	-	2	3	2	2
3	3	2	2	2	1	-	-	1	-	2	-	2	3	2	2
4	3	2	2	2	1	-	-	1	-	2	-	2	3	2	2
5	3	2	2	2	1	-	-	1	-	2	-	2	3	2	2
AVG	3	2	2	2	1	-	-	1	-	2	-	2	3	2	2

1-Low 2-Medium 3-High ‘-‘ – No Correlation.

23EEP510 PROTECTION AND SWITCHGEAR L T P C
3 0 0 3

OBJECTIVES

- To understand the causes of abnormal operating conditions (faults, lightning, and switching surges) in apparatus and systems.
- To learn about the characteristics and functions of relays.
- To study apparatus protection and its significance.
- To know evolution of relays from electromechanical to numerical types.
- To know hw circuit breakers function.

UNIT I PROTECTION SCHEMES 9

Principles and need for protective schemes - Nature and causes of faults – Types of faults - Effects of Faults. Fault Statistics - Methods of Neutral Grounding - Zones of protection and essential qualities of protection - Protection schemes.

UNIT II ELECTROMAGNETIC RELAYS 9

Operating principles of relays - Universal relay - Torque equation - R-X diagram - Electromagnetic relays over current, directional, distance, differential, negative sequence and under frequency relays.

UNIT III APPARATUS PROTECTION 9

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line - Apparatus protection using artificial intelligence (AI) techniques.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION 9

Static relays - Phase, Amplitude Comparators - Synthesis of various relays using Static comparators - Block diagram of Numerical relays Numerical over current protection, Numerical transformer differential protection, Numerical distance protection of transmission lines.

UNIT V CIRCUIT BREAKERS 9

Physics of arcing phenomenon and arc interruption - Re-striking voltage and recovery voltage Rate of rise of recovery voltage - Resistance switching - Current chopping - Interruption of capacitive current Air blast, Air break, Oil, SF_6, MCBs, MCCBs and vacuum circuit breakers - Rating and selection of circuit breakers. Testing of Circuit breakers.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Design different types of faults and earthing in the power system.
- Develop an understanding of various types of relays.
- Analyze and select different types of protective schemes for generators, transformers, bus bars, and feeders.
- Summarize the importance of static relays.
- Apply knowledge of different circuit breakers and suggest a suitable circuit breaker for a particular operation.

TEXT BOOKS

1. Sunil S.Rao, "Switchgear Protection and power systems", Khanna Publishers, New Delhi, Fourteenth Edition, 2019.
2. B. Rabindranath and N. Chander, "Power System Protection and Switchgear", New Age International (P) Ltd, Third Edition, 2023.

REFERENCES

1. Badri Ram and B.H.Vishwakarma, "Power System Protection and Switchgear", New Age International Pvt Ltd , Third Edition, 2023.
2. M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakrabarti, "A Text Book on Power System Engineering", Dhanpat Rai & Co., Third Edition, 2023.

E-RESOURCES

1. https://nptel.ac.in/courses/108/105/108105167/ - (Power System Protection)
2. https://nptel.ac.in/courses/108/101/108101039/ - (Power System Protection)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	-	-	2	-	2	-	2	3	2	2
2	3	3	2	2	1	-	-	2	-	2	-	2	3	2	2
3	3	3	2	2	1	-	-	2	-	2	-	2	3	2	2
4	3	3	2	2	1	-	-	2	-	2	-	2	3	2	2
5	3	3	2	2	1	-	-	2	-	2	-	2	3	2	2
AVG	3	3	2	2	1	-	-	2	-	2	-	2	3	2	2

1-Low 2-Medium 3-High '-' – No Correlation.

23EEP511 **MODERN POWER CONVERTERS** **L T P C**
3 0 0 3

OBJECTIVES

- To understand switched-mode power supplies.
- To learn about the design and analysis of AC to DC converters.
- To study the concept of cascade multilevel inverters.
- To learn about the design and analysis of AC to AC converters
- To know about soft switching converter techniques.

UNIT I SWITCHED MODE POWER SUPPLIES 9

DC Power supplies and Classification; Switched mode dc power supplies - with and without isolation, single and multiple outputs; Closed loop control and regulation; Design examples on converter and closed loop performance.

UNIT II AC-DC CONVERTERS 9

Single and three phase topologies - Switching techniques - High input power factor. reduced input current harmonic distortion, Improved efficiency, with and without input-output isolation, performance indices design examples. Effect of source impedance and overlap ,reactive power and power balance in converter circuits.

UNIT III DC-AC CONVERTERS 9

Multi-level Inversion - concept, classification of multilevel inverters, Principle of operation, main features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters; Modulation schemes. Problems.

UNIT IV AC-AC CONVERTERS WITH AND WITHOUT DC LINK 9

Matrix converters. Basic topology of matrix converter- Modulation techniques - Scalar modulation, indirect modulation; Matrix converter as only AC-DC converter; AC-AC converter with DC link - topologies and operation - with and without resonance link - converter with dc link converter; Performance comparison with matrix converter with DC link converters.

UNIT V SOFT SWITCHING POWER CONVERTER 9

Soft switching techniques. ZVS, ZCS, quasi resonance operation; Performance comparison hard switched and soft switched converters.AC-DC converter, DC-DC converter, DC-AC converter.; Resonant DC power supplies.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Design the converter and assess closed-loop performance.
- Develop an understanding of power converter performance using AC-DC converters.
- Describe about diode-clamped inverters.
- Analyze modulation techniques.
- Apply the importance of hard-switched and soft-switched converters.

TEXT BOOKS

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Fourth Edition, 2023.
2. P.C. Sen., "Modern Power Electronics", S. Chand Publications, Second Edition, 2020.

REFERENCES

1. Mohan N.,Undeland and Robbins, "Power Electronics-Converters, Applications and Design", John Wiley and sons, Inc., New York, Second Edition, 2019.
2. Agarwal, "Power Electronics: Converters, Applications, and Design", Prentice Hall India, Third Edition, 2019.

E- RESOURCES

1. https://nptel.ac.in/courses/108/105/108105066/ - (Power converter)
2. https://nptel.ac.in/courses/108/107/108107128/ - (Advanced power electronics)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	3	3	-	3	1	-	2	-	2	3	2	3
2	3	2	3	3	3	-	3	1	-	2	-	2	3	2	3
3	3	2	3	3	3	-	3	1	-	2	-	2	3	2	3
4	3	2	3	3	3	-	3	1	-	2	-	2	3	2	3
5	3	2	3	3	3	-	3	1	-	2	-	2	3	2	3
AVG	3	2	3	3	3	-	3	1	-	2	-	2	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

23EEP512 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS L T P C
3 0 0 3

OBJECTIVES

- To study the design of various power converters, including AC to DC, DC to DC, and AC to AC converters, for renewable energy systems.
- To know how to develop maximum power point tracking algorithms.
- To understand stand-alone and grid-connected renewable energy systems.
- To learn the various operating modes of wind electrical generators.
- To study the challenges and power electronics for renewable energy system.

UNIT I INTRODUCTION 9

Overview of renewable energy sources: solar, wind, hydro, biomass - Introduction to power electronics: importance and applications - Basic power electronic devices: diodes, transistors, IGBTs, and thyristors - Converter topologies: DC-DC, AC-DC, DC-AC, and AC-AC converters - Control strategies for power electronic converters.

UNIT II POWER ELECTRONICS FOR SOLAR PHOTOVOLTAIC SYSTEM 9

PV cells, modules, and arrays - Power electronic interfaces for PV systems: DC-DC converters, Maximum Power Point Tracking (MPPT) - Inverters for grid-connected and standalone PV systems - Design and analysis of PV systems with power electronics.

UNIT III POWER ELECTRONICS FOR WIND ENERGY CONVERSION SYSTEM 9

Basics of wind energy conversion: wind turbines and generators - Power electronic converters for wind energy systems: rectifiers, inverters - Control strategies for variable-speed and fixed-speed wind turbines -Grid integration of wind energy: challenges and solutions.

UNIT IV GRID INTEGRATION OF RENEWABLE ENERGY SYSTEM 9

Grid codes and standards for renewable energy integration - Power quality issues in renewable energy systems - Grid-tied inverters: synchronization, reactive power control, and protection - Islanding detection methods and anti-islanding protection - Impact of high penetration of renewables on grid stability.

UNIT V EMERGING TECHNOLOGIES AND ADVANCED TOPICS 9

Energy storage systems: batteries, supercapacitors, and flywheels - Power electronics for hybrid renewable energy systems - Smart grids and the role of power electronics in distributed generation - Electric vehicles and charging infrastructure: power electronic challenges - Future trends.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Create different power converters, namely AC to DC, DC to DC, and AC to AC converters for renewable energy sources.
- Design various types of renewable energy sources.
- Apply knowledge about maximum power point tracking algorithms.
- Analyze various operating modes of wind electrical generators and solar energy systems.
- Explain different aspects of power electronics and their applications.

TEXT BOOKS

1. Sudipta Chakraborty, Marcelo G. Simes, and William E. Kramer. "Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration". Springer Science & Business, Second Edition, 2019.
2. Andrzej M.Trzynnadlowski, "Introduction to Modern Power Electronics", Wiley India Pvt. Ltd, Third Edition, 2021.

REFERENCES

1. Ali Keyhani, "Design of Smart Power Grid Renewable Energy Systems", Wiley-IEEE Press, Third Edition, 2019.
2. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, "Grid Converters for Photovoltaic and Wind Power Systems", John Wiley and Sons, Ltd., Fourth Edition, 2024.

E- RESOURCES

1. https://nptel.ac.in/courses/121/106/121106014/ - (Renewable Energy)
2. https://www.pdfdrive.com/-(Power electronics for renewable energy systems transportation and industrial applications)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	-	-	1	-	2	-	1	3	2	2
2	3	2	2	2	1	-	-	1	-	2	-	1	3	2	2
3	3	2	2	2	1	-	-	1	-	2	-	1	3	2	2
4	3	2	2	2	1	-	-	1	-	2	-	1	3	2	2
5	3	2	2	2	1	-	-	1	-	2	-	1	3	2	2
AVG	3	2	2	2	1	-	-	1	-	2	-	1	3	2	2

1-Low 2-Medium 3-High '-' – No Correlation.

PROFESSIONAL ELECTIVE III

23EEP513 DISCRETE TIME SYSTEM AND SIGNAL PROCESSING LT P C

3 0 0 3

OBJECTIVES

- To learn the signals and systems & their mathematical representation.
- To know about discrete time systems.
- To study transformation techniques & their computation.
- To understand the filters and their design for digital implementation.
- To know programmability digital signal processor & quantization effects.

UNIT I INTRODUCTION 9

Classification of systems - Continuous - Discrete - Linear - Causal - Stability - Dynamic - Recursive - Time variance classification of signals - Continuous and discrete - Energy and power - Mathematical representation of signals - Spectral density - Sampling techniques - Quantization - Quantization error - Nyquist rate - Aliasing effect.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 9

Z-transform and its properties - Inverse Z-transforms - Difference equation - Solution by Z transform - Application to discrete systems - Stability analysis - Frequency response - Convolution.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 9

Discrete Fourier Transform – Properties - Magnitude and phase representation - Computation of DFT using FFT algorithm - DIT & DIF using radix 2 FFT - Butterfly structure.

UNIT IV DESIGN OF DIGITAL FILTERS 9

FIR & IIR filter realization - Parallel & cascade forms - FIR design: Windowing Techniques - Need and choice of windows - Linear phase characteristics - Analog filter design - Butterworth and Chebyshev approximations; IIR Filters - Digital design using impulse invariant and bilinear transformation Warping - Pre warping.

UNIT V DIGITAL SIGNAL PROCESSORS 9

Introduction - Architecture - Features - Addressing Formats - Functional modes - Introduction to CommercialDS Processors.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Discuss the importance of Fourier transforms digital filters and DS Processors.
- Apply knowledge on Signals and systems & their mathematical representation.
- Analyze the discrete time systems.
- Analyze the transformation techniques & their computation.
- Describe programmability digital signal processor & quantization effects.

TEXT BOOKS

1. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, New Delhi, PHI. Fifth Edition, 2018.
2. S. K. Mitra, "Digital Signal Processing - A Computer Based Approach", McGraw Hill Edu, Fourth Edition, 2021.

REFERENCES

1. Poorna Chandra S, Sasikala. B , "Digital Signal Processing", Vijay Nicole/TMH, Third Edition, 2017.
2. Robert Schilling & Sandra L.Harris, "Introduction to Digital Signal Processing using Matlab", Cengage Learning, Third Edition, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/117102060/NPTEL - (Introduction of signal processing)
2. https://nptel.ac.in/courses/108/105/108105055/ - (Discrete time system and signal)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	-	2	1	-	-	-	2	3	-	3
2	3	3	3	2	-	-	2	1	-	-	-	2	3	-	3
3	3	3	3	2	-	-	2	1	-	-	-	2	3	-	3
4	3	3	3	2	-	-	2	1	-	-	-	2	3	-	3
5	3	3	3	2	-	-	2	1	-	-	-	2	3	-	3
AVG	3	3	3	2	-	-	2	1	-	-	-	2	3	-	3

1- Low 2-Medium 3-High '-' – No Correlation.

23EEP514 **EMBEDDED SYSTEM DESIGN** **LT P C**
3 0 0 3

OBJECTIVES

- To learn about the Building Blocks of an embedded System and Software Tools
- To understand input/output interfacing with bus Communication protocol.
- To study the ISR and scheduling for the multitasking process.
- To learn the basics of real-time operating system
- To discuss the applications based on embedded design approaches.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems–Structural units in Embedded processor, selection of processor& memory devices- DMA Memory management methods- Timer and Counting devices, Real Time Clock, In-circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS485 – CAN Bus-Serial Peripheral Interface (SPI) – Inter-Integrated Circuits(I2C).

UNIT III INTERRUPTS THE SERVICE MECHANISM AND DEVICE DRIVER 9

Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline–Introduction to Device Drivers.

UNIT IV RTOS-BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication- shared memory, message passing - Interprocess Communication-Introduction to process synchronization using semaphores.

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Embedded Product Development Life Cycle - Case Study: Precision Agriculture – Autonomous car.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Design the hardware functional and software strategies required to develop various embedded systems.
- Apply the basic differences between various Bus communication standards.
- Compute the incorporation of the interface as Interrupt services.
- Apply the various scheduling algorithms through a Real time operatingsystem.
- Analyze the various embedded concepts for developing automation applications.

TEXT BOOKS

1. Rajkamal, "Embedded system - Architecture, Programming, Design", McGraw-Hill Edu, Fourth Edition, 2020.
2. Peckol, "Embedded system Design", John Wiley & Sons, 2021.

REFERENCES

1. Shibu. K. V, "Introduction to Embedded Systems", Tata Mcgraw Hill, Second Edition, 2019.
2. L.Das, "Embedded Systems", Pearson Education, Third Edition, 2022.

E-RESOURCES

1. https://nptel.ac.in/courses/106/105/106105193/ - (Introduction to Embedded System)
2. https://nptel.ac.in/courses/106105159/ - (Embedded System Design)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	-	-	-	-	-	-	-	2	2	3
2	3	2	3	2	1	-	-	-	-	-	-	-	2	1	3
3	3	3	2	3	1	-	-	-	-	-	-	-	2	1	2
4	3	2	2	2	1	-	-	-	-	-	-	-	1	2	3
5	3	2	1	2	1	-	-	-	-	-	-	-	3	1	2
AVG	3	2.2	2	2.2	1	-	-	-	-	-	-	-	2	1.4	2.6

1- Low 2-Medium 3-High '-' – No Correlation.

23EEP515 **EMBEDDED C- PROGRAMMING** **LT P C**
3 0 0 3

OBJECTIVES

- To know the basic concept to the students for fundamentals of embedded Programming.
- To acquire knowledge an Introduce the GNU C Programming tool Chain.
- To study the basic concepts of embedded C.
- To learn to teach the basics of 8051 Programming.
- To understand the knowledge in interfacing 8051.

UNIT I BASIC C PROGRAMMING **9**

Typical C Program Development Environment - Introduction to C Programming - Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

UNIT II EMBEDDED C **9**

Adding Structure to „C" Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

UNIT III 8051 PROGRAMMING IN C **9**

Data types and time delay in 8051, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051.

UNIT IV 8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C **9**

Basics of serial communication, 8051 interface to RS232- serial port programming in 8051. 8051 interrupts and programming, Programming for timer configuration.

UNIT V 8051 INTERFACING **9**

8051: ADC interfacing , DAC interfacing, Sensor interfacing, LCD interfacing, Stepper motor interfacing.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Design insight into an embedded C programming and its salient features for embeddedsystems.
- Analyze the software and hardware architecture for distributed computing in embeddedsystems
- Develop a solution for problems by using the concept learned in programming using theembedded controllers
- Develop simple applications with 8051 by using its various features and interfacing withvarious external hardware.
- Improve Employability and entrepreneurship capacity due to knowledge upgradation onrecent trends in embedded programming skills.

TEXTBOOKS

1. Paul Deitel and Harvey Deitel, “C How to Program”, Pearson Education Limited, First Edition 2022.
2. Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.

REFERENCES

1. Noel Kalicharan, "Learn to Program with C", Apress Inc., Second Edition, 2023.
2. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, „The 8051 Microcontrollerand Embedded Systems‟ Prentice Hall, Second Edition, 2014.

E-RESOURCES

1. https://nptel.ac.in/courses/106105193(Embedded programming)
2. https://nptel.ac.in/courses/106105159/ (Embedded System Design)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	-	-	-	-	-	-	-	2	2	3
2	3	2	3	2	1	-	-	-	-	-	-	-	2	1	3
3	3	3	2	3	1	-	-	-	-	-	-	-	2	1	2
4	3	2	2	2	1	-	-	-	-	-	-	-	1	2	3
5	3	2	1	2	1	-	-	-	-	-	-	-	3	1	2
AVG	3	2.2	2	2.2	1	-	-	-	-	-	-	-	2	1.4	2.6

1-Low 2-Medium 3-High ‘-‘ – No Correlation.

23EEP516 EMBEDDED CONTROL FOR ELECTRIC DRIVES LT P C
3 0 0 3

OBJECTIVES

- To learn the basic control concept for electrical drives
- To study the need of embedded systems for controlling the electrical drives
- To know about various embedded system based controlstrategies for drives
- To study optimization and machine learningtechniques used in electrical drives
- To know to familiarize the high-performance computing for electrical drives.

UNIT I INTRODUCTION ELECTRICAL DRIVES 9

Electric drive and its classifications, Four-quadrant drive, Dependence of load torque on various factors, Dynamics of motor-load combination-Solid State Controlled Drives-Machine learning and optimization techniques for electrical drives- IoT for Electrical drives applications.

UNIT II EMBEDDED PROCESSOR 9

Embedded Processor architecture - RTOS - Hardware/software co-design Programming and optimization with SoC processors - control algorithms implementation for power converter.

UNIT III INDUCTION MOTOR CONTROL 9

Types - Speed control methods - PWM techniques- VSI fed three - phase induction motor-Fuzzy logic Based speed control for three phase induction motor - FPGA based three phase induction motor control.

UNIT IV BLDC MOTOR CONTROL 9

Overview of BLDC Motor - Speed control methods - PWM techniques - ARM processor based BDLC motor control - ANN for BLDC Motor control and operation.

UNIT V SRM MOTOR CONTROL 9

Overview of SRM Motor - Speed control methods - PWM techniques - FPGA based SRM motor control - DNN for SRM Motor control and operation.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Analyze the significance of embedded control for electrical drives
- Summarize the various control strategy for electrical drives.
- Developing knowledge on Machine learning and optimization techniques for motor control.
- Develop embedded system solution for real time application such as Electric vehicles and UAVs.
- Apply the recent trends in embedded system for motor control strategy.

TEXTBOOKS

1. R. Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, First Edition, 2022.
2. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization”, Willey, First Edition, 2019.

REFERENCES

1. Ron Sass and Anderew G. Schmidt, “Embedded System design with platform FPGAs: Principles and Practices”, Elsevier, 2021.
2. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2020.

E- RESOURCES

1. https://nptel.ac.in/courses/108/105/108105062(Industrial automation and control)
2. https://nptel.ac.in/courses/108/106/108106182(Electric Vehicle)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	2	2	1	-	-	-	-	-	-	-	2	1	2
2	2	1	3	2	1	-	-	-	-	-	-	-	2	1	2
3	3	2	3	3	3	-	-	-	-	-	-	-	1	3	3
4	3	2	3	3	3	-	-	-	-	-	-	-	3	3	3
5	3	2	1	2	1	-	-	-	-	-	-	-	2	2	3
AVG	2.4	1.6	2.4	2.4	1.8	-	-	-	-	-	-	-	2	2	2.6

1-Low 2-Medium 3-High ‘-‘ – No Correlation.

23EEP517 **MICROCONTROLLER BASED SYSTEM DESIGN** **LT P C**

3 0 0 3

OBJECTIVES

- To study the architecture of PIC controller.
- To learn to educate on use of interrupts and timers.
- To understand to teach on the peripheral devices for data transfer and communication
- To study the functional blocks of ARM processor.
- To acquire knowledge on the architecture of ARM Processors.

UNIT I INTRODUCTION TO PIC MICROCONTROLLER 9

Introduction to PIC Microcontroller - PIC 16C6x and PIC16C7x Architecture - IC16cxx - Pipelining - Program Memory considerations - Register File Structure - Instruction Set - Addressing modes - Simple Operations.

UNIT II INTERRUPTS AND TIMER 9

PIC micro controller Interrupts - External Interrupts - Interrupt Programming - Loop time subroutine Timers -Timer Programming - Front panel I/O - Soft Keys - State machines and key switches - Display of Constant and Variability strings.

UNIT III PERIPHERALS AND INTERFACING 9

I2C Bus for Peripherals Chip Access - Bus operation-Bus subroutines - Serial EEPROM - Analogto Digital Converter - UART- Baud rate selection - Data handling circuit - Initialization - LCD and keyboard Interfacing -ADC - DAC -Sensor Interfacing.

UNIT IV INTRODUCTION TO ARM PROCESSOR 9

Architecture - ARM programmer"s model - ARM Development tools - Memory Hierarchy - ARM Assembly Language Programming - Simple Examples - Architectural Support for Operatingsystems.

UNIT V ARM ORGANIZATION 9

3 Stage Pipeline ARM Organization - 5Stage Pipeline ARM Organization - ARM Instruction Execution - ARM Implementation - ARM Instruction Set - ARM coprocessor interface - Architectural support for High Level Languages - Embedded ARM Applications.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Develop the architectures of processors.
- Analyze Interrupts and timers.
- Discuss the importance of Peripheral devices for data communication.
- Design and develop the basics to ARM Processor.
- Explain architecture of ARM processors.

TEXT BOOKS

1. M. Bates, “PIC Microcontrollers”, Newnes, Third Edition, 2021.
2. Andrew N.Sloss, Dominic Symes, Chris Wright, “ARM Developer"s Guide”, Elsevier, First Edition, 2020

REFERENCES

1. W.A. Smith, “ARM Microcontroller Interfacing: Hardware and Software”, Elketor, First Edition, 2019.
2. Kenneth Ayala, “The 8051 Microcontroller & Embedded Systems Using Assembly and C”, Cengage Learning, First Edition, 2018.

E-RESOURCES

1. https://nptel.ac.in/courses/117/104/117104072/ - (PIC Microcontroller)
2. https://nptel.ac.in/courses/117/106/117106111/ - (ARM Processor)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1					1		2	3	1	3
2	3	2	2	2	2					1		2	3	1	3
3	3	2	2	2	2					1		2	3	1	3
4	3	2	2	2	1					1		2	3	1	3
5	3	2	2	2	2					1		2	3	1	3
AVG	3	2	2	2	2					1		2	3	1	3

1-Low 2-Medium 3-High ‘-‘ – No Correlation.

23EEP518 EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS LT P C
3 0 0 3

OBJECTIVES

- To understand the fundamentals and building of electronic engine controlsystems.
- To study to teach on sensor functional components for vehicles.
- To learn to discuss on programmable controllers for vehicles management systems.
- To study logics of automation & communication techniques for vehicle.
- To know to introduce the infotainment system development.

UNIT I INTRODUCTION TO AUTOMOTIVE SYSTEMS 9

Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Electronic control Unit– open-source ECU.

UNIT II SENSORS AND ACTUATORS FOR AUTOMOTIVES 9

Review of automotive sensors- sensors interface to the ECU, Smart sensor and actuators forautomotive applications.

UNIT III VEHICLE MANAGEMENT SYSTEMS 9

Energy Management system - Adaptive cruise control - anti-locking braking system - Safety andCollision Avoidance.

UNIT IV ONBOARD DIAGONSTICS AND COMMUNICATION 9

OBD , Vehicle communication protocols - Bluetooth, CAN, LIN, FLEXRAY and MOST.

UNIT V RECENT TRENDS 9

Navigation - Autonomous car- Role of IoT in Automotive systems.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Develop insight into the significance of the role of embedded system for automotive applications.
- Summarize the need, selection of sensors and actuators and interfacing with ECU
- Develop the Embedded concepts for vehicle management and control systems.
- Analyze the need of Electrical vehicle and able to apply the embedded system technologyfor various aspects of EVs
- Apply the knowledge up gradation on recent trends in embedded systems design and itsapplication in automotive systems.

TEXTBOOKS

1. William B. Ribbens, "Understanding Automotive Electronics", Elseiver, Eighth Edition, 2019.
2. L.Vlacic, M.Parent, F.Harahima, "Intelligent Vehicle Technologies", SAE International, First Edition, 2020.

REFERENCES

1. Robert Bosch, "Automotive Electricals Electronics System and Components", Fifth Edition, 2021.
2. Automotive Hand Book, Robert Bosch, Bently Publishers, Tenth Edition, 2018.

E-RESOURCES

1. https:/nptel.ac.in/courses/106/105/106105193-(Embedded system design with arm)
2. https://nptel.ac.in/courses/106/103/106103182-(Embedded system design)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	3	2	2	1	-	-	-	-	-	-	-	2	1	3
2	2	3	3	2	2	-	-	-	-	-	-	-	2	2	2
3	3	3	3	3	3	-	-	-	-	-	-	-	2	1	3
4	3	3	3	3	3	-	-	-	-	-	-	-	1	3	2
5	3	3	1	2	1	-	-	-	-	-	-	-	2	2	3
AVG	2.4	3	2.4	2.4	2	-	-	-	-	-	-	-	1.8	1.8	2.6

1-Low 2-Medium 3-High '-' – No Correlation.

SENGUNTHAR ENGINEERING COLLEGE
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS 2023

MINOR DEGREE / HONOURS

ELECTRIC VEHICLES

ANNEXURE - V

CURRICULUM AND SYLLABI

SENGUNTHAR
ENGINEERING COLLEGE
TIRUCHENGODE
EDUCATION EDIFICATION ELEVATION
Estd. 2001

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CURRICULUM AND SYLLABI

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(MINOR/HONOURS DEGREE – ELECTRIC VEHICLES)

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Course Code	Name of the Subject	Category	Periods /Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23EEET01	Electric and Hybrid Vehicles	PC	3	0	0	3	40	60	100
23EEET02	Electric Motors and Drives for Electric Vehicles	PC	3	0	0	3	40	60	100
23EEET03	Advanced EV Technologies	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23EEEE01	Battery and Controls for Electric Vehicles	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23EEEP01	Project Work	EEC	0	0	12	6	60	40	100
Total			19						

PC : Professional Core
EEC : Employability Enhancement Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

SEMESTER III

23EEET01	ELECTRIC AND HYBRID VEHICLES	LT P C 3 0 0 3

OBJECTIVES

- To understand the fundamentals and evolution of electric vehicles
- To study battery technologies for electric vehicles
- To know electric machines and their applications in EVs
- To study electric vehicle drive train components and configurations
- To learn hybrid electric vehicle architectures and designs

UNIT I INTRODUCTION TO ELECTRIC VEHICLES 9

History and evolution of Evs - Components of electric vehicles - Comparison with internal combustion engines: Technology, benefits, and challenges - EV classification and electrification levelsb - EV terminology and concepts - Efficiency analysis for EVs vs. ICE vehicles.

UNIT II BATTERY TECHNOLOGIES FOR EVs 9

Battery basics and types - Key parameters: Capacity, discharge rate, state of charge, depth of discharge - Technical characteristics of EV batteries - Battery pack design principles - Properties and performance of EV batteries - Overview of battery safety and thermal runaway prevention.

UNIT III ELECTRIC MACHINES FOR EV APPLICATIONS 9

Motor and engine rating for Evs - Requirements of EV motors - DC machines and BLDC in Evs - Three-phase AC machines - Induction motors for Evs - Permanent magnet machines - Switched reluctance machines in EV applications - Introduction to motor cooling techniques.

UNIT IV EV DRIVE TRAIN SYSTEMS AND COMPONENTS 9

Transmission configurations for Evs - Drive train components: Gears, chain Drive , Belt drive differentials, clutches - Brake systems and regenerative braking - Motor sizing for EV applications - Integration of drive train components - Basics of torque vectoring in EV drive trains.

UNIT V HYBRID ELECTRIC VEHICLE ARCHITECTURES 9

Types of hybrid configurations - Series, parallel, and series-parallel - Design considerations for HEVs - Drive train layouts for different hybrid architectures - Sizing of components in hybrid systems - Energy management strategies in HEVs - Range extenders in hybrid vehicles - Retrofit hybrid system design.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Discuss the working principles and evolution of electric vehicles
- Summarize the characteristics and design of battery systems for EVs
- Describe the construction and operation of various electric motors used in EVs
- Analyze EV drive train components and configurations
- Develop different hybrid electric vehicle architectures

TEXT BOOKS

1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", CRC Press, Third Edition, 2022.
2. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, Second Edition, 2019.

REFERENCES

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, Third Edition, 2020.
2. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, Second Edition, 2022

E-RESOURCES

1. https://nptel.ac.in/courses/108103009 - (Hybrids and Electric Vehicle)
2. http://nptel.ac.in/courses/108103009/ - (Electric Vehicle)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
2	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
3	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
4	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
5	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
AVG	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER IV

23EEET02 ELECTRIC MOTORS AND DRIVES FOR ELECTRIC VEHICLES LT P C
3 0 0 3

OBJECTIVES

- To study characteristics and parameters of EV motors.
- To understand various electric drive concepts for EVs.
- To learn control mechanisms for DC and AC EV motors.
- To know advanced motor technologies used in modern EVs.
- To understand drive systems for special EV motors.

UNIT I FUNDAMENTALS OF EV MOTORS AND DRIVES 9

EV motor requirements; Comparison of motor types for EVs; Torque-speed characteristics; Power semiconductors in EV drives - IGBTs and MOSFETs; Basic drive types and selection criteria for EVs. Overview of motor efficiency maps

UNIT II DC MOTORS AND DRIVES FOR EVs 9

PMDC motor principles and characteristics; DC motor control techniques; DC-DC converters for PMDC motors; Chopper control; Closed-loop control strategies; Regenerative braking in DC drives. Introduction to multiphase DC motors for EVs

UNIT III AC INDUCTION MOTORS AND DRIVES FOR EVs 9

Induction motor operation in EVs; IGBT-based inverter design; PWM techniques for induction motor control; V/f control principles; Vector control basics; Efficiency considerations in induction motor drives. Brief overview of thermal management in EV drives

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) AND DRIVES 9

PMSM principles and advantages for EVs; PMSM types - surface mounted and interior; Field-oriented control of PMSM; PMSM drive system design; Comparison between PMSM and induction motor drives for EVs. Introduction to noise, vibration, and harshness (NVH) considerations in PMSM

UNIT V SPECIAL ELECTRIC MACHINES FOR EVs 9

Brushless DC (BLDC) motors - hub and inner rotor types; BLDC motor control techniques; Switched Reluctance Motors (SRM) for EVs; SRM drive strategies; In-wheel motor technology; Axial flux motors; Thermal management in EV motors and Drive. Overview of fault-tolerant motor designs

TOTAL : 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Discuss characteristics and parameters of various EV motors
- Analyze electric drive concepts specific to EVs
- Design and analyze control systems for DC and AC EV motors
- Examine advanced motor technologies used in modern EVs
- Develop drive systems for special EV motors

TEXT BOOKS

1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", CRC Press, Third Edition, 2022.
2. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, Second Edition, 2019.

REFERENCES

1. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, First Edition, 2023.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", CRC Press, Third Edition, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/108104140 - Electric Drives
2. https://nptel.ac.in/courses/108108077 - Electric Vehicles

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
2	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
3	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
4	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
5	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
AVG	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER V

23EEET03	ADVANCED EV TECHNOLOGIES	LT P C
		3 0 0 3

OBJECTIVES

- To understand advanced charging technologies and Vehicle-to-Grid (V2G) systems
- To study lightweight materials and thermal management in EVs
- To know autonomous driving technologies in EVs
- To understand EV economics, policies, and cybersecurity
- To study EV maintenance, diagnostics, and end-of-life recycling

UNIT I ADVANCED CHARGING TECHNOLOGIES AND V2G 9

Wireless charging systems; Ultra-fast charging; Vehicle-to-Grid (V2G) technology; Smart charging infrastructure; Charging standards and protocols; Integration with renewable energy sources. Overview of extreme fast charging technologies and challenges.

UNIT II LIGHTWEIGHT MATERIALS AND THERMAL MANAGEMENT 9

Advanced materials for EV body and chassis; Composite materials; Weight reduction strategies; Battery thermal management systems; Powertrain cooling; Cabin climate control for EVs.Introduction to structural batteries in EVs.

UNIT III AUTONOMOUS DRIVING AND EV INTEGRATION 9

Sensors and Perception systems for EVs; Autonomous driving levels; Energy management in autonomous EVs; Integration of EV and autonomous technologies; Safety considerations. Introduction to ADAS and Connected Vehicles. Sensor fusion in autonomous EVsCameras, LiDAR (Light Detection and Ranging), RADAR (Radio Detection and Ranging), GPS (Global Positioning System) / GNSS (Global Navigation Satellite System)Accelerometers and Gyroscopes.

UNIT IV EV ECONOMICS, POLICY, AND CYBER SECURITY 9

Total cost of ownership analysis; Government incentives and policies; Market trends and forecasting; Cybersecurity threats in EVs; Security protocols and best practices; Over-the-air updates. Comparative study of 2 wheeler and 3 wheeler Retrofit unit Vs New EV.

UNIT V EV MAINTENANCE, DIAGNOSTICS, AND RECYCLING 9

EV-specific maintenance procedures; Diagnostic tools and techniques; Troubleshooting EV systems; Battery second-life applications; Recycling processes for EV components; Environmental impact assessment. Overview of EV battery remanufacturing and repurposing

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Analyze advanced charging technologies and V2G systems.
- Examine lightweight materials and thermal management techniques in EVs.
- Develop the integration of autonomous driving technologies in EVs.
- Analyze EV economics, policies, and cyber security considerations.
- Explain EV maintenance, diagnostics, and end-of-life recycling.

TEXT BOOKS

1. Carla Fabiana Chiasserini et al., "Electric Vehicles in Smart Grids: Charging Strategies", Springer, 2021.
2. David Greenwood, "Advanced Electric Drive Vehicles", CRC Press, 2020.

REFERENCES

1. Seref Soylu, "Electric Vehicles - Modelling and Simulations", InTech, 2022.
2. Tom Denton, "Electric and Hybrid Vehicles", Routledge, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/108103009 - (Advanced Electric Vehicles)
2. https://www.edx.org/course/electric-vehicle-technology-business - (Electric Vehicles: Technology, Business, and Policy)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
2	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
3	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
4	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
5	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3
AVG	2	1	2	3	2	1	1	1	-	1	-	1	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER VI

23EEEE01	**BATTERY AND CONTROLS FOR ELECTRIC VEHICLES**	**LT P C**
	(Lab Embedded Theory Course)	**3 0 2 4**

OBJECTIVES

- To understand different types of energy storage systems and EV chargers.
- To study battery characteristics, parameters, and modelling.
- To learn about battery management systems and pack design.
- To understand EV charging infrastructure and technologies.
- To study battery testing, recycling, and integration with renewable energy.
- To learn to design and analyze drive systems for performance optimization.

UNIT I ENERGY STORAGE SYSTEMS AND BATTERY CHARACTERISTICS 9

Types of energy storage: Lead Acid, Nickel-based, Lithium-based, Metal Air batteries; Ultra capacitors; Flywheel Energy Storage. Battery specifications; Efficiency; Electrical parameters; Heat generation; Performance criteria for EV batteries; Power and energy requirements. Battery parameter estimation techniques.

UNIT II BATTERY MODELING AND MANAGEMENT SYSTEMS 9

General modeling approach; Simulation models for Li-ion and NiCd batteries; Parameterization. Battery selection for EVs/HEVs; Traction battery pack design; State of charge estimation; Cell equalization; Thermal management; Battery Management System (BMS)components and functions. Overview of cell balancing techniques in battery packs

UNIT III BATTERY TESTING, DISPOSAL, AND RECYCLING 9

Safety testing; Transport and storage limitations; Recycling and second-life applications; Environmental impacts; Recycling methods for EV batteries. Fuel Cells and Hydrogen-based system design. Accelerated aging tests for EV batteries

UNIT IV EV CHARGING TECHNOLOGIES AND INFRASTRUCTURE 9

Types of EV chargers; AC and DC charging; Charger modes; EVSE associated charge times. AC and DC Pile Chargers; EVSE Power Module selection; Communication Protocols; Open Charge Point Protocol (OCPP); Bharat DC001 & AC001 Charger specifications. overview of cyber security in EV charging infrastructure

UNIT V CHARGING CONNECTORS AND RENEWABLE INTEGRATION 9

AC and DC charger types and connectors; Charging standards (IEC 61851-1, IEC 61851-24, 62196-2). PV module technologies for EV charging; Inverter selection and sizing; Cable and earthing selection; Relevant IEC standards for solar integration. bidirectional charging and V2G concepts

LIST OF EXPERIMENTS

1. Battery characterization and performance evaluation
2. Battery management system simulation
3. EV charger efficiency and performance testing
4. Charging protocol implementation and testing
5. Solar PV integration with EV charging station
6. EV charger efficiency and performance testing (AC and DC charging)
7. Simulation and Implementation and testing of different PWM techniques for motor control

TOTAL: 45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Describe different types of energy storage systems and EV chargers
- Analyze battery performance for EVs
- Design and evaluate battery management systems
- Develop EV charging infrastructure
- Analyze renewable energy sources with EV charging systems
- Design, and analyze electric drive systems, allowing for performance optimization and problem-solving.

TEXT BOOKS

1. Ibrahim Dinçer et al., "Thermal Management of Electric Vehicle Battery Systems", John Wiley & Sons, 2019.
2. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons, Second Edition, 2022.

REFERENCES

1. Chris Mi et al., "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Wiley, Second Edition, 2021.
2. Amir Khajepour et al., "Electric and Hybrid Vehicles: Technologies, Modeling and Control: A Mechatronic Approach", John Wiley & Sons, 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/113105102 - (Battery Modeling)
2. https://nptel.ac.in/courses/108102047 - (Energy Storage)
3. https://nptel.ac.in/courses/108102121 - (Electric Vehicles)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	3	2	1	-	2	-	2	1	1	3	2	3
2	2	1	2	3	2	1	-	2	-	2	1	1	3	2	3
3	2	1	2	3	2	1	-	2	-	2	1	1	3	2	3
4	2	1	2	3	2	1	-	2	-	2	1	1	3	2	3
5	2	1	2	3	2	1	-	2	3	2	1	1	3	2	3
6	2	1	2	3	2	1	-	2	3	2	1	1	3	2	3
AVG	2	1	2	3	2	1	-	2	3	2	1	1	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER VII

23EEEP01 **PROJECT WORK** **L T P C**
0 0 12 6

OBJECTIVES

- To develop skills to formulate a technical project.
- To develop the ability to solve specific problem.
- To teach use of new tools, algorithms and techniques for projects.
- To provide guidance on product validation and cost-effectiveness analysis
- To provide guidelines to prepare technical report of the project.

GUIDELINE FOR REVIEW AND EVALUATION

Students work in groups of 3 on an approved topic under faculty guidance. Progress is evaluated through a minimum of three reviews. A project report is required at the end of the semester. Evaluation is based on oral presentation and the project report, judged jointly by external and internal examiners.

TOTAL: 180 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Test and validate prototypes and analyze thecost-effectiveness.
- Prepare technical report and oral presentations.
- Take up challenging practical engineering problems and find better solutions.

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	-	2	-	-	2	3	-	3	3	3	2	3
2	2	1	2	-	2	-	-	2	3	-	3	3	3	2	3
3	2	1	2	-	2	-	-	2	3	-	3	3	3	2	3
4	2	1	2	-	2	-	-	2	3	-	3	3	3	2	3
5	2	1	2	-	2	-	-	2	3	-	3	3	3	2	3
AVG	2	1	2	-	2	-	-	2	3	-	3	3	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS 2023

MINOR DEGREE / HONOURS

SENSOR TECHNOLOGY

ANNEXURE - VII

CURRICULUM AND SYLLABI

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CURRICULUM AND SYLLABI

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(MINOR/HONOURS DEGREE – SENSORS TECHNOLOGY)

B. E. - ELECTRICAL AND ELECTRONICS ENGINEERING

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23EEST01	Nanomaterials and Sensors	PC	3	0	0	3	40	60	100
23EEST02	Wireless Sensor Networks	PC	3	0	0	3	40	60	100
23EEST03	Flexible and Wearable Sensors	PC	3	0	0	3	40	60	100
EMBEDDED COURSE									
23EESE01	Principles of Sensors	PC	3	0	2	4	50	50	100
EMBLOYABILITY ENHANCEMENT COURSE									
23EESP01	Project Work	EEC	0	0	12	6	60	40	100
Total			19						

PC : Professional Core
EEC : Employability Enhancement Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

SEMESTER III

23EEST01	NANOMATERIALS AND SENSORS	L T P C
		3 0 0 3

OBJECTIVES

- To know an insight of nanomaterials and its synthesis and to expose the students to the different methods being used for nanomaterials characterization.
- To understand the students about the process involved in the fabrication of sensors using metallic nano particles and nanowires and the need for using special materials like CNTs for sensor development.
- To learn the knowledge of developing sensors using different nano structures of metal oxides.
- To understand the developments in the nano polymers and its role insensors.
- To learn an insight of quantum dots and its potential application in sensor development.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Definition of nanotechnology - Main features of nano-materials - Types of nano structures (0D, 1D, and 2D structures) - Synthesis of nano-materials and nano-composites - Chemical/Physical/Electrical/Optical properties of nano-materials and composites.

UNIT II CHARACTERIZATION OF NANOMATERIALS 9

Methods for characterizing the nano-materials: Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and spectroscopy - spectrometry based surface analysis techniques.

UNIT III METAL NANOPARTICLE AND NANOWIRE BASED SENSORS 9

Definition of nanoparticle - Features of nanoparticles - Production of nanoparticles by physical and chemical approaches – Definition of nanowires - Features of nanowires - Fabrication of individual nanowire by top – Down approaches and bottom–up approaches - Fabrication of nanowire arrays (fluidic channel, blown bubble film, contact printing, spray coating, etc.).

UNIT IV CARBON NANOTUBE BASED SENSORS 9

Definition of carbon nanotube - Features of carbon nanotubes - Synthesis of carbon nanotubes - Fabrication and working principles of sensors based on individual carbon nanotube - Fabrication and working principles of sensors based on random array of carbon nanotubes.

UNIT V SENSOR BASED NANOSTRUCTURES OF METAL OXIDE 9

Synthesis of metal oxide structures by dry and wet methods - Types of metal oxide gas sensors (0D, 1D and 2D) - Defect chemistry of the metal oxide sensors - Sensing mechanism of metal - Oxide gas sensors - Porous metal - Oxide structures for improved sensing applications.

TOTAL : 45 PERIODS

OUTCOMES

Upon Completion of the course, the students will be able to:

- Analyze an insight of nanomaterials and its synthesis.
- Summarize the different methods being used forn a nomaterials characterization.
- Develop the process involved in the fabrication of sensors using metallic nanoparticles and nanowires.
- Analyze the different sensors used for carbon nanotube.
- Develop sensors using different nanostructures of metal oxides for making it more specific

TEXT BOOKS

1. Dieter Vollath, “Nanomaterials: An Introduction to Synthesis, Properties and Applications”, Wiley, New Jersey, Second Edition, 2019.
2. Guozhong Cao, “Nanostructures & Nanomaterials: Synthesis, Properties & Applications”, Imperial College Press, London, Second Edition, 2021

REFERENCES

1. Martin Pumera, “Nanomaterials for Electrochemical Sensing and Bio sensing”, Pan Stanford, First Edition, 2022.
2. Michael A. Carpenter, Sanjay Mathur, Andrei Kolmakov, “Metal Oxide Nanomaterials for Chemical Sensors”, Springer, NewYork, First Edition, 2018.

E-RESOURCES

1. https://nptel.ac.in/courses/118104008-(Nanomaterial)
2. https://nptel.ac.in/courses/108106173-(sensor)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	3	-	1	1	1	-	1	-	3	3	1	3
2	2	1	2	3	-	1	1	1	-	1	-	3	3	1	3
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5	2	1	2	3	-	1	1	1	-	1	-	3	3	1	3
AVG	2	1	2	3	-	1	1	1	-	1	-	3	3	1	3

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER IV

23EEST02	WIRELESS SENSOR NETWORKS	L T P C
		3 0 0 3

OBJECTIVES

- To study the central elements in the design of communication protocols for the WSNs.
- To learn the design knowledge in analyzing the specific requirements for applications in WSNs regardingenergy supply, memory, processing and transmission capacity.
- To know the perception of mobile ad hoc networks, design, implementation issues, and solutions.
- To study different algorithms and protocols for power management, sensor data routing and query processing.
- To know associate, hardware platforms and software frame works used to realize dynamic Wireless sensor network.

UNIT I NETWORK EMBEDDED SYSTEMS 9

RS232, RS485, SPI, I2C, CAN, LIN, FLEXRAY.

UNIT II EMBEDDED WIRELESS COMMUNICATION AND IP BASED WSN 9

Bluetooth, Zigbee, Wifi, UWB Circuit switching, packet switching, concept of IPV4, IPV6, 6 LOW PAN and IP, IP based WSN, 6 LOW PAN based WSN, IOT.

UNIT III WIRELESS SENSOR NETWORK (WSN) 9

Characteristic and challenges, WSN vs Adhoc Networks, Sensor node architecture, Physical layer and transceiverde sign considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

UNIT IV WSN (Medium Access Control) 9

Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts, Contention Based protocols, Schedule-based protocols - SMAC - BMAC, Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MACprotocol.

UNIT V SENSOR NETWORK ARCHITECTURE 9

Data Dissemination, Flooding and Gossiping - Data gathering Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design Principles for WSNs - Gateway Concepts, Need for gateway, WSN and Internet Communication, WSN Tunneling

TOTAL: 45 PERIODS

OUTCOMES

Upon Completion of the course, the students will be able to:

- Design the applicability and limitations of communication protocols for are altime WSN application.
- Analyze the behavior of Mobile Adhoc Networks (MANETs) and correlates the infrastructure-based networks.
- Describe the routing protocols function and their implications on data transmission delay and bandwidth.
- Analyze networks with an attempt to reduce issue of broad cast and flooding techniques.
- Develop appropriate algorithms to improve existing or to develop new wireless sensor network applications.

TEXT BOOKS

1. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, NewJersey, First Edition, 2021.
2. Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks: A Networking Perspective", Wiley-IEEE Press, USA, First Edition, 2019.

REFERENCES

1. Waltenegus W.Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", John Wiley & Sons, NewJersey, First Edition, 2018.
2. RIan F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", John Wiley & Sons, NewJersey, First Edition, 2021.

E-RESOURCES

1. https://nptel.ac.in/courses/106106167 - (Introduction to wireless communications)
2. https://nptel.ac.in/courses/106105160 -(wireless Ad Hoc and Sensor Network)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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5	2	1	2	3	-	1	1	1	-	1	-	3	3	2	3
AVG	2	1	2	3	-	1	1	1	-	1	-	3	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER V

23EEST03	FLEXIBLE AND WEARABLE SENSORS	LT P C 3 0 0 3

OBJECTIVES

- To learn the overview of flexible electronics technology and the issues with materials processing for thin film electronics.
- To study the students for the materials selection and patterning methods for thin film electronics development.
- To learn the process involved in transferring the flexible electronics from foils to textiles and also the challenges, opportunities and the future of wearable devices.
- To know the challenges of wearable sensors employed for sensing the physical and biological parameters.
- To understand the process involved in conversion of conducting and semiconducting fibers to smart textiles.

UNIT I OVERVIEW OF FLEXIBLE ELECTRONICS TECHNOLOGY 9

History of flexible electronics - Materials for flexible electronics: degrees of flexiblility, substrates, backplane electronics, front plane technologies, encapsulation - Fabrication technology for flexible electronics - Fabrication on sheets by batch processing, fabrication on web by Roll-to-Roll processing - Additive printing.

UNIT II MATERIALS AND NOVEL PATTERNING METHODS FOR FLEXIBLE ELECTRONICS 9

Materials considerations for flexible electronics: Overview, Inorganics semiconductors and dielectrics, organic semiconductors and dielectrics, conductors - Print processing options for device fabrication: Overview, control of feature sizes of jet printed liquids, jet printing for etchmask patterning, methods for minimizing feature size, printing active materials.

UNIT III FLEXIBLE ELECTRONICS FROM FOILS TO TEXTILES 9

Introduction -Thin film transistors: Materials and Technologies - Review of semiconductors employed in flexible electronics - Thin film transistors based on IGZO - Plastic electronics for smart textiles - Improvements and limitations.

UNIT IV WEARABLE HAPTICS 9

World of wearables - Attributes of wearables - Textiles and clothing: The meta wearable Challenges and opportunities - Future of wearables - Need for wearable haptic devices - Categories of wearable haptic and tactile display.

UNIT V KNITTED ELECTRONIC TEXTILES 9

From fibers to textile sensors - Interlaced network -Textile sensors for physiological state monitoring - Biomechanical sensing - Noninvasive sweat monitoring by textile sensors and other applications. FBG sensor in Intelligent Clothing and Biomechanics.

TOTAL: 45 PERIODS

OUTCOMES

Upon Completion of the course, the students will be able to:

- Demonstrate the technology developments in the flexible electronics technology.
- Examine to identify the suitable materials and its processing for the development of thin film electronics.
- Design the pattern and develop with suitable patterning methods.
- Analyze the process involved in the transformation of electronics from foils to textiles
- Design knowledge for developing wearable sensors for physical and chemical parameters

TEXTBOOKS

1. Michael J. McGrath, Cliodhna Ni Scanaill, Dawn Nafus, “Sensor Technologies Healthcare, Wellness and Environmental Applications”, Apress Media LLC, New York First Edition, 2021.
2. William S. Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, Springer, New York, First Edition, 2021.

REFERENCES

1. Edward Sazonov, Michael R. Newman, “Wearable Sensors: Fundamentals, Implementation and Applications”, Academic Press, Cambridge, Second Edition, 2023.
2. Kate Hartman, “Make: Wearable Electronics: Design, prototype, and wear your interactive garments”, Marker Media, Netherlands, Second Edition, 2018.

E-RESOURCES

1. https://nptel.ac.in/courses/108108112-(Semiconductor Device)
2. https://nptel.ac.in/courses/108108031-(Electronics Systems)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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5	2	1	2	3	-	1	1	1	-	1	-	3	3	1	3
AVG	2	1	2	3	-	1	1	1	-	1	-	3	3	1	3

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER VI

23EESE01	PRINCIPLES OF SENSORS	LT P C 3 0 4 4

OBJECTIVES

- To learn in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterised, and analysed.
- To understand the various sources and detectors of various Optical sensing mechanisms.
- To study in-depth understanding of the principle of measurement, and theory of instruments andsensors for measuring velocity and acceleration.
- To understand the fundamental knowledge on the basic laws and phenomena on which operation of sensortransformation of energy is based.
- To learn the concept of flow, temperature and acoustic sensors.
- To know a reasonable level of competence in the design, construction, and execution ofmechanical measurements strain, force, torque and pressure.

UNIT I SENSOR FUNDAMENTALS AND OPTICAL DETECTORS 9

Sensor Classification, Performance and Types, Error Analysis characteristics Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, thermal detectors, photo multipliers, photoconductive detectors, photodiodes, avalanche photodiodes, CCDs.

UNIT II INTENSITY POLARIZATION AND INTERFEROMETRIC SENSORS 9

Intensity sensor, Microbending concept, Interferometers, Phase sensor: Phase detection, Polarization maintaining fibers.

UNIT III VELOCITY AND ACCELERATION SENSORS 9

Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes.

UNIT IV POSITION, DIRECTION, DISPLACEMENT AND LEVEL SENSORS 9

Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall effect, magneto resistive, magneto strictive sensors. Fiber optic liquid level sensing, Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor.

UNIT V FLOW, TEMPERATURE AND ACOUSTIC SENSORS 9

Flow sensors: pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. microflow sensor, coriolis mass flow and drag flow sensor. Temperature sensors - thermoresistive, thermoelectric, semiconductor and optical. Piezoelectric temperature sensor. Acoustic sensors - microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.

List of Experiments

1. Strain, Force, pressure, and torque measurement
   Strain measurement with Bridge Circuit
   Develop a displacement measurement system with the following sensors:
   i. Inductive transducer (LVDT)
   ii. Hall effect sensor
2. After studying the characteristics of temperature sensors listed below,develop a temperature measurement system for a particular application using the suitable sensor.
   i. Thermocouple principles
   ii. Thermistor and linearization of NTC Thermistor
3. Develop a sensor system for force measurement using piezoelectric transducer.
4. Measurement of shear strain and angle twist using strain gauge is not suitable for many applications. Based on other sensing experiments carried out suggest a non- contact method and try to complete its proof of concept.

TOTAL: 45 + 15 = 60 PERIODS

OUTCOMES

Upon Completion of the course, the students will be able to:

- Analyze the concepts in common methods for converting a physical parameter into an electrical quantity
- Describe appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
- Design and develop sensors using optical methods with desired properties
- Evaluate performance characteristics of different types of sensors
- Design different type of sensors used in real life applications and paraphrase their importance
- Develop the analytical design and solutions for sensors.

TEXTBOOKS

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", Springer, New York, Fourth Edition, 2020.
2. Jon. S. Wilson, "Sensor Technology Hand Book", Elsevier, Netherland, First Edition, 2019.

REFERENCES

1. Gerd Keiser,"Optical Fiber Communications", , McGraw-Hill Science, Delhi, Fourth Edition, 2022.
2. John G Webster, "Measurement, Instrumentation and sensor Handbook", CRC Press, Florida, Second Edition, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/105101206 - (Remote sensing)
2. https://nptel.ac.in/courses/115107122 - (Optical Sensor)

Mapping of Cos-Pos & PSOs

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6	2	1	2	3	3	1	1	1	3	1	-	3	3	2	3
AVG	2	1	2	3	3	1	1	1	3	1	-	3	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

SEMESTER VII

23EESP01	**PROJECT WORK**	**L T P C** **0 0 12 6**

OBJECTIVES

- To identify a specific problem for the current need of the society and collecting information related to thesame through detailed review of literature.
- To build up skills to formulate a technical project.
- To develop the methodology to solve the identified problem.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 works on a topic approved by the head of the department under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

OUTCOMES

Upon Completion of the course, the students will be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Prepare technical report and oral presentations.
- At the end of the course the students will have a clear idea of their area of work and they will be in aposition to carry out the remaining phase II work in a systematic way.

Mapping of Cos-Pos & PSOs

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4	2	1	2	-	2	-	-	2	3	-	3	3	3	2	3
5	2	1	2	-	2	-	-	2	3	-	3	3	3	2	3
AVG	2	1	2	-	2	-	-	2	3	-	3	3	3	2	3

1-Low 2-Medium 3-High '-' – No Correlation.

SCHEME

Credit Summary

CURRICULUM AND SYLLABI

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(MINOR DEGREE /HONOURS)

CREDIT SUMMARY

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

Category	Credits Per Semester								Credit Total
	I	II	III	IV	V	VI	VII	VIII	
PC	-	-	6	6	6	8	-	-	26
EEC	-	-	-	-	-	-	12	-	12
Total	-	-	6	6	6	8	12	-	38