SHREE VENKATESHWARA HI-TECH ENGINEERING COLLEGE
(Autonomous)
Gobichettipalayam, Erode-638455

Regulation 2023

Curriculum and Syllabus

Choice Based Credit System (CBCS)

BE- ELECTRICAL AND ELECTRONICS ENGINEERING

	SHREE VENKATESHWARA HI-TECH ENGINEERING COLLEGE **(Autonomous)** **Gobichettipalayam, Erode -638455**
Regulation 2023 (UG) **Curriculum and Syllabus** **BE- Electrical And Electronics Engineering**	

I. Program Educational Objective (PEO)

PEO1 : **Core Sector Employment:** Find employment in Core Electrical and Electronics Engineering and service sectors.

PEO2 : **Managerial skills:** Get elevated to technical lead position and lead the organization competitively.

PEO3 : **Higher Education and Consultancy:** Enter into higher studies leading to post-graduate and research degrees. Become consultant and provide solutions to the practical problems of core organization.

PEO4 : **Entrepreneurial skills:** Become an entrepreneur and be part of electrical and electronics product and service industries.

II. Program Outcomes (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. **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.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with approprate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **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.

5. **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.

6. **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.

7. **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.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **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.

11. **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.

12. **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.

III. Program Specific Outcomes (PSOs)

PSO1 : **Foundation of Electrical Engineering:** 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, conservation and energy saving. Students can assess the power management, auditing, crisis and energy saving aspects.

PSO2 : **Foundation of Mathematical Concepts:** Ability to apply mathematical methodologies to solve problems related with electrical engineering using appropriate engineering tools and algorithms.

PSO3: **Computing and Research Ability:** Ability to use knowledge in various domains to identify research gaps and hence to provide solution which leads to new ideas and innovations.

Mapping of Course Outcome and Programme Outcome

Year	Sem	Course name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I	Induction Programme															
		Professional English - I	1.6	2.2	1.8	2.2	1.5	3	3	3	1.6	3	3	3	-	-	-
		Matrices and Calculus	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
		Engineering Physics	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-
		Engineering Chemistry	2.8	1.3	1.6	1	-	1.5	1.8	-		-	-	1.5	-	-	-
		Problem Solving and Python Programming	2	3	3	3	2	c	-	-	-	-	2	2	3	3	3
		தமிழர் மரபு /Heritage of Tamils	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Problem Solving and Python Programming Laboratory	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3
		Physics and Chemistry Laboratory	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-
			2.6	1.3	1.6	1	1	1.4	1.8	-	-	-	-	1.3	-	-	-
		English Laboratory	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
	II	Professional English - II	3	3	3	3	2.75	3	3	3	2.2	3	3	3	-	-	-
		Numerical Methods and Statistics	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
		Physics for Electronics Engineering	3	2	1			1	-	-	-	-	-	-	-	-	-
		Engineering Graphics	2	-	-	0.2	-	-	1	2	1.2	2	-	-	-	-	-
		Basic Civil and Mechanical Engineering	3	1	2		2	-	-	-	-	3		2	2	2	
		Circuit Analysis	3	3	3	2.8	2		2	1				3	3	3	3
		தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Circuits Laboratory	3	3	3	3	3		2	1.5	3			3	3	3	2
		Engineering Practices Laboratory	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
		Communication Laboratory	2.4	2.8	3	3	1.8	3	3	3	3	3	3	3	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

SUMMARY OF CREDITS

S. No	Course Category	Credits per Semester								Total Credits	Credits in %	Credits as per AU Curriculum R-2021	Credits as per AICTE Model Curriculum R-2023
		I	II	III	IV	V	VI	VII	VIII				
1	HSS	4	3					5		12	7.06	12	15
2	BS	12	7	4	2					25	14.71	25	23
3	ES	5	9							14	8.24	14	17
4	PC		6	20.5	19.5	12.5	7.5	4		70	41.18	69	61
5	PE					9	9	3		21	12.35	21	12
6	OE						3	9		12	7.06	12	12
7	EEC	1	2	1				2	10	16	9.41	14	20
8	MC		√		√	√	√			0	0.00		-
Total Credits / Semester		**22**	**27**	**25.5**	**21.5**	**21.5**	**19.5**	**23**	**10**	**170**	**100**	**167**	**160**

CATEGORIZATION OF COURSES

i. Humanities and Social Sciences including Management Courses (HSS)
ii. Basic Science Courses (BS)
iii. Engineering Science Courses (ES)
iv. Professional Core Courses (PC)
v. Professional Elective Courses (PE)
vi. Open Elective Courses (OE)
vii. Mandatory Courses (MC)
viii. Employability Enhancement Courses (EEC)
ix. Other Courses (OC)

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

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SEMESTER I

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Induction Program											
1.	23IPA11	Induction Programme	-	-	-	-	-	0	-	-	-
Theory											
2.	23ENT11	Professional English - I	HSS	3	0	0	3	3	40	60	100
3.	23MAT11	Matrices and Calculus	BS	3	1	0	4	4	40	60	100
4.	23PHT11	Engineering Physics	BS	3	0	0	3	3	40	60	100
5.	23CYT11	Engineering Chemistry	BS	3	0	0	3	3	40	60	100
6.	23CST11	Problem Solving and Python Programming	ES	3	0	0	3	3	40	60	100
7.	23TAT11	தமிழர் மரபு /Heritage of Tamils	HSS	1	0	0	1	1	40	60	100
Practicals											
8.	23CSL11	Problem Solving and Python Programming Laboratory	ES	0	0	4	4	2	60	40	100
9.	23PCL11	Physics and Chemistry Laboratory	BS	0	0	4	4	2	60	40	100
10.	23ENL11	English Laboratory	EEC	0	0	2	2	1	60	40	100
		Total		**16**	**1**	**10**	**27**	**22**			

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SEMESTER II

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23ENT21	Professional English - II	HSS	2	0	0	2	2	40	60	100
2.	23MAT21	Numerical Methods and Statistics	BS	3	1	0	4	4	40	60	100
3.	23PHT24	Physics For Electronics Engineering	BS	3	0	0	3	3	40	60	100
4.	23ECT21	Circuit Analysis	PC	3	1	0	4	4	40	60	100
5.	23MET21	Engineering Graphics	ES	2	0	4	6	4	40	60	100
6.	23MET22	Basic Civil and Mechanical Engineering	ES	3	0	0	3	3	40	60	100
7.	23TAT21	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HSS	1	0	0	1	1	40	60	100
Practicals											
8.	23ECL21	Circuits Analysis Laboratory	PC	0	0	4	4	2	60	40	100
9.	23MEL21	Engineering Practices Laboratory	ES	0	0	4	4	2	60	40	100
10.	23ENL21	Communication Laboratory	EEC	0	0	4	4	2	60	40	100
Mandatory Course											
11.	23MCL21	Mandatory Course – I &	MC	0	0	1	1	0	100	-	100
			Total	**17**	**2**	**16**	**35**	**27**			

& Mandatory Course-I

Yoga for Human Excellence	Non-credit Course

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SEMESTER III

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23EET31	Electrical Machines - I	PC	3	0	0	3	3	40	60	100
2.	23EET32	Electromagnetic Fields	PC	3	1	0	4	4	40	60	100
3.	23EET33	Digital Logic Circuits	PC	3	0	0	3	3	40	60	100
4.	23ECT34	Electron Devices and Circuits	PC	3	0	0	3	3	40	60	100
5.	23CST34	C Programming and Data Structures	PC	3	0	0	3	3	40	60	100
6.	23MAT33	Probability and Complex Functions	BS	3	1	0	4	4	40	60	100
Practicals											
7.	23EEL31	Electrical Machines Laboratory – I	PC	0	0	3	3	1.5	60	40	100
8.	23ECL32	Electronic Devices and Circuits Laboratory	PC	0	0	3	3	1.5	60	40	100
9.	23CSL34	C Programming and Data Structures Laboratory	PC	0	0	3	3	1.5	60	40	100
10.	23PDL31	Professional Development	EEC	0	0	2	2	1	100	-	100
		Total		**18**	**2**	**11**	**31**	**25.5**			

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SEMESTER IV

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23EET41	Electrical Machines - II	PC	3	0	0	3	3	40	60	100
2.	23EET42	Linear Integrated Circuits	PC	3	0	0	3	3	40	60	100
3.	23EET43	Microprocessor and Microcontroller	PC	3	0	0	3	3	40	60	100
4.	23EET44	Transmission and Distribution	PC	3	0	0	3	3	40	60	100
5.	23EET45	Measurements and Instrumentation	PC	3	0	0	3	3	40	60	100
6.	23CYT41	Environmental Sciences and Sustainability	BS	2	0	0	2	2	40	60	100
Practicals											
7.	23EEL41	Electrical Machines Laboratory - II	PC	0	0	3	3	1.5	60	40	100
8.	23EEL42	Linear and Digital Circuits Laboratory	PC	0	0	3	3	1.5	60	40	100
9.	23EEL43	Microprocessor and Microcontroller Laboratory	PC	0	0	3	3	1.5	60	40	100
Mandatory Course											
10.	23SAT41	Soft and Analytical Skills-I&	MC	1	0	0	1	0	-	-	-
		Total		**17**	**0**	**9**	**26**	**21.5**			

& Soft and Analytical Skills-I is a Non-credit Course

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SEMESTER V

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23EET51	Power System Analysis	PC	3	0	0	3	3	40	60	100
2.	23EET52	Power Electronics	PC	3	0	0	3	3	40	60	100
3.	23EET53	Control Systems	PC	3	0	0	3	3	40	60	100
4.		Professional Elective I*	PE	-	-	-	-	3	-	-	100
5.		Professional Elective II*	PE	-	-	-	-	3	-	-	100
6.		Professional Elective III*	PE	-	-	-	-	3	-	-	100
Practicals											
7.	23EEL51	Power Electronics Laboratory	PC	0	0	3	3	1.5	60	40	100
8.	23EEL52	Control and Instrumentation Laboratory	PC	0	0	4	4	2	60	40	100
Mandatory Course											
9.		Mandatory Course-II &	MC	3	0	0	3	0	100	-	100
10.	23SAT51	Soft and Analytical Skills-II &&	MC	1	0	0	1	0	-	-	-
		Total		**-**	**-**	**-**	**-**	**21.5**			

* **Professional Elective–I to III shall be chosen from the list of Professional electives (Verticals) offered by same Programme**

& Mandatory Course-II is a Non-credit Course

&& Soft and Analytical Skills-II is a Non-credit Course

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SEMESTER VI

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23EET61	Protection and Switchgear	PC	3	0	0	3	3	40	60	100
2.	23EET62	Power System Operation and Control	PC	3	0	0	3	3	40	60	100
3.		Professional Elective – IV*	PE	-	-	-	-	3	-	-	100
4.		Professional Elective – V*	PE	-	-	-	-	3	-	-	100
5.		Professional Elective – VI*	PE	-	-	-	-	3	-	-	100
6.		Open Elective – I**	OE	-	-	-	-	3	-	-	100
Practicals											
7.	23EEL61	Power System Laboratory	PC	0	0	3	3	1.5	60	40	100
Mandatory Course											
8.		Mandatory Course-III &	MC	3	0	0	3	0	100	-	100
Total				-	-	-	-	**19.5**			

* **Professional Elective–IV to VI shall be chosen from the list Professional electives (Vertical) offered by same Programme**

** **Open Elective – I shall be chosen from the list of open electives offered by other Programmes**

& Mandatory Course-III is a Non-credit Course

@ The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration (02Weeks) during VI semester summer vacation. After the completion of training, a detailed report should be submitted within ten days from the commencement of VII semester.

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SEMESTER VII

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23EET71	High Voltage Engineering	PC	3	0	0	3	3	40	60	100
2.		Professional Elective VII*	PE	-	-	-	-	3	-	-	100
3.	23UHV71	Human Values and Ethics	HSS	2	0	0	2	2	40	60	100
4.		Elective – Management#	HSS	3	0	0	3	3	40	60	100
5.		Open Elective – II**	OE	-	-	-	-	3	-	-	100
6.		Open Elective – III**	OE	-	-	-	-	3	-	-	100
7.		Open Elective – IV**	OE	-	-	-	-	3	-	-	100
Practicals											
8.	23EEL71	Mini Project	EEC	0	0	4	4	2	40	60	100
9.	23EEL72	Summer Internship @	PC	0	0	0	0	1	100	-	100
			Total	-	-	-	-	**23**			

*** Professional Elective – VII shall be chosen from the list Professional electives (Verticals) offered by same Programme**

**** Open Elective – II to IV shall be chosen from the list of open electives offered by other Programmes**

 # Elective – Management shall be chosen from the list of Elective – Management course

@ The students undergone summer internship during VI semester summer vacation and same will be evaluated in VII semester.

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SEMESTER VIII

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Practicals											
1.	23EEL81	Project Work	EEC	0	0	20	20	10	40	60	100
			Total	**0**	**0**	**20**	**20**	**10**			

Total Credits = 170

MANDATORY COURSES II

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MCT51	Introduction to Women and Gender Studies	MC	3	0	0	3	0	100	-	100
2.	23MCT52	Elements of Literature	MC	3	0	0	3	0	100	-	100
3.	23MCT53	Film Appreciation	MC	3	0	0	3	0	100	-	100
4.	23MCT54	Disaster Risk Reduction and Management	MC	3	0	0	3	0	100	-	100

MANDATORY COURSES III

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MCT61	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	0	0	3	0	100	-	100
2.	23MCT62	History of Science and Technology in India	MC	3	0	0	3	0	100	-	100
3.	23MCT63	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0	100	-	100
4.	23MCT64	State, Nation Building and Politics in India	MC	3	0	0	3	0	100	-	100
5.	23MCT65	Industrial Safety	MC	3	0	0	3	0	100	-	100

ELECTIVE – MANAGEMENT COURSES

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MSE71	Principles of Management	HSS	3	0	0	3	3	40	60	100
2.	23MSE72	Total Quality Management	HSS	3	0	0	3	3	40	60	100
3.	23MSE73	Engineering Economics and Financial Accounting	HSS	3	0	0	3	3	40	60	100
4.	23MSE74	Human Resource Management	HSS	3	0	0	3	3	40	60	100
5.	23MSE75	Knowledge Management	HSS	3	0	0	3	3	40	60	100
6.	23MSE76	Industrial Management	HSS	3	0	0	3	3	40	60	100

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Professional Elective	Vertical I Power Engineering	Vertical II Converters and Drives	Vertical III Embedded Systems	Vertical IV Electric Vehicle Technology	Vertical V Advanced Control	Vertical VI Diversified Courses
1.	Utilization and Conservation of Electrical Energy	Special Electrical Machines	Embedded System Design	Electric Vehicle Architecture	Process Modeling and Simulation	Energy StorageSystems
2.	Under Ground Cable Engineering	Analysis of Electrical Machines	Embedded C-Programming	Design of Motor and Power Converters for Electric Vehicles	Computer Control of Processes	Hybrid EnergyTechnology
3.	Substation Engineering and Automation	Multilevel Power Converters	Embedded Processors	Electric Vehicle Design, Mechanics and Control	System Identification	Design and Modelling of Renewable EnergySystems
4.	HVDC and FACTS	Electrical Drives	Embedded Control for Electric Drives	Design of Electric Vehicle Charging System	Model Based Control	Grid integrating Techniques andChallenges
5.	Energy Management and Auditing	SMPS and UPS	Smart System Automation	Testing of Electric Vehicles	Non Linear Control	Sustainable and Environmental FriendlyHV Insulation System
6.	Power Quality	Power Electronics for Renewable Energy Systems	Embedded System for Automotive Applications.	Grid Integration of Electric Vehicles	Optimal Control	Power SystemTransients
7.	Smart Grids	Control of Power Electronics Circuits	VLSI Design	Intelligent control of Electric Vehicles.	Adaptive Control	PLC Programming
8.	Restructured Power Market	-	MEMS and NEMS	-	Machine Monitoring System	Big Data Analytics
9.	-	-	Digital Signal Processing System Design	-	-	-

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2023, (Clause 12).

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL I : POWER ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23EEE11	Utilization and Conservation of Electrical Energy	PE	3	0	0	3	3	40	60	100
2.	23EEE12	Under Ground Cable Engineering	PE	3	0	0	3	3	40	60	100
3.	23EEE13	Substation Engineering and Automation	PE	3	0	0	3	3	40	60	100
4.	23EEE14	HVDC and FACTS	PE	3	0	0	3	3	40	60	100
5.	23EEE15	Energy Management and Auditing	PE	3	0	0	3	3	40	60	100
6.	23EEE16	Power Quality	PE	3	0	0	3	3	40	60	100
7.	23EEE17	Smart Grid	PE	3	0	0	3	3	40	60	100
8.	23EEE18	Restructured Power Market	PE	3	0	0	3	3	40	60	100

VERTICAL II : CONVERTERS AND DRIVES

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23EEE21	Special Electrical Machines	PE	2	0	2	4	3	50	50	100
2.	23EEE22	Analysis of Electrical Machines	PE	2	0	2	4	3	50	50	100
3.	23EEE23	Multilevel Power Converters	PE	2	0	2	4	3	50	50	100
4.	23EEE24	Electrical Drives	PE	2	0	2	4	3	50	50	100
5.	23EEE25	SMPS and UPS	PE	2	0	2	4	3	50	50	100
6.	23EEE26	Power Electronics for Renewable Energy Systems	PE	2	0	2	4	3	50	50	100
7.	23EEE27	Control of Power Electronics Circuits	PE	2	0	2	4	3	50	50	100

VERTICAL III : EMBEDDED SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23EEE31	Embedded System Design	PE	2	0	2	4	3	50	50	100
2.	23EEE32	Embedded C- programming	PE	2	0	2	4	3	50	50	100
3.	23EEE33	Embedded Processors	PE	2	0	2	4	3	50	50	100
4.	23EEE34	Embedded Control for Electric Drives	PE	2	0	2	4	3	50	50	100
5.	23EEE35	Smart System Automation	PE	2	0	2	4	3	50	50	100
6.	23EEE36	Embedded System for Automotive Applications	PE	2	0	2	4	3	50	50	100
7.	23EEE37	VLSI Design	PE	2	0	2	4	3	50	50	100
8.	23EEE38	MEMS and NEMS	PE	2	0	2	4	3	50	50	100
9.	23EEE39	Digital Signal Processing System Design	PE	2	0	2	4	3	50	50	100

VERTICAL IV : ELECTRIC VEHICLE TECHNOLOGY

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23EEE41	Electric Vehicle Architecture	PE	3	0	0	3	3	40	60	100
2.	23EEE42	Design of Motor and Power Converters for Electric Vehicles	PE	2	0	2	4	3	50	50	100
3.	23EEE43	Electric Vehicle Design, Mechanics and Control	PE	2	0	2	4	3	50	50	100
4.	23EEE44	Design of Electric Vehicle Charging System	PE	2	0	2	4	3	50	50	100
5.	23EEE45	Testing of Electric Vehicles	PE	2	0	2	4	3	50	50	100
6.	23EEE46	Grid Integration of Electric Vehicles	PE	3	0	0	3	3	40	60	100
7.	23EEE47	Intelligent Control of Electric Vehicles	PE	2	0	2	4	3	50	50	100

VERTICAL V: ADVANCED CONTROL

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23EEE51	Process Modeling and Simulation	PE	3	0	0	3	3	40	60	100
2.	23EEE52	Computer Control of Processes	PE	3	0	0	3	3	40	60	100
3.	23EEE53	System Identification	PE	3	0	0	3	3	40	60	100
4.	23EEE54	Model Based Control	PE	3	0	0	3	3	40	60	100
5.	23EEE55	Non Linear Control	PE	3	0	0	3	3	40	60	100
6.	23EEE56	Optimal Control	PE	3	0	0	3	3	40	60	100
7.	23EEE57	Adaptive Control	PE	3	0	0	3	3	40	60	100
8.	23EEE58	Machine Monitoring System	PE	3	0	0	3	3	40	60	100

VERTICAL VI - DIVERSIFIED COURSES

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23EEE61	Energy Storage Systems	PE	3	0	0	3	3	40	60	100
2.	23EEE62	Hybrid Energy Technology	PE	3	0	0	3	3	40	60	100
3.	23EEE63	Design and Modeling of Renewable Energy Systems	PE	3	0	0	3	3	40	60	100
4.	23EEE64	Grid integrating Techniques and Challenges	PE	2	0	2	4	3	50	50	100
5.	23EEE65	Sustainable and Environmental Friendly HV Insulation System	PE	3	0	0	3	3	40	60	100
6.	23EEE66	Power System Transients	PE	3	0	0	3	3	40	60	100
7.	23EEE67	PLC Programming	PE	3	0	0	3	3	40	60	100
8.	23EEE68	Big Data Analytics	PE	2	0	2	4	3	50	50	100

OPEN ELECTIVES

S. NO.	COURSE CODE	COURSE TITLE	Category	PERIODS PER WEEK			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
OFFERED BY DEPARTMENT OF CIVIL ENGINEERING											
1	23CEO11	Civil and Infrastructure Engineering	OE	3	0	0	3	3	40	60	100
2	23CEO12	Environmental Pollution and waste management	OE	3	0	0	3	3	40	60	100
3	23CEO13	Environmental Impact Assessment	OE	3	0	0	3	3	40	60	100
4	23CEO14	Building Services	OE	3	0	0	3	3	40	60	100
5	23CEO15	Water, Sanitation and Health	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING											
1	23CSO11	Foundation of AR/VR	OE	2	0	2	4	3	50	50	100
2	23CSO12	Web Designing	OE	2	0	2	4	3	50	50	100
3	23CSO13	Block Chain fundamentals	OE	2	0	2	4	3	50	50	100
4	23CSO14	Knowledge Management	OE	2	0	2	4	3	50	50	100
5	23CSO15	Cloud Computing Essentials	OE	2	0	2	4	3	50	50	100
OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING											
1	23ECO11	Basics of electronics in automation	OE	3	0	0	3	3	40	60	100
2	23ECO12	Optical engineering	OE	3	0	0	3	3	40	60	100
3	23ECO13	E-waste management	OE	3	0	0	3	3	40	60	100
4	23ECO14	Consumer electronics	OE	3	0	0	3	3	40	60	100
5	23ECO15	Principles of communication engineering	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING											
1.	23EEO11	Renewable Energy Sources	OE	3	0	0	3	3	40	60	100
2.	23EEO12	Electrical Vehicle	OE	3	0	0	3	3	40	60	100
3.	23EEO13	Energy Auditing and Conservation	OE	3	0	0	3	3	40	60	100
4.	23EEO14	Domestic and Industrial Electrical Installations	OE	3	0	0	3	3	40	60	100
5.	23EEO15	Microcontroller Based System Design	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF MECHANICAL ENGINEERING											
1	23MEO11	Industrial Instrumentation	OE	3	0	0	3	3	40	60	100
2	23MEO12	Energy Technology	OE	3	0	0	3	3	40	60	100

3	23MEO13	Reverse Engineering	OE	3	0	0	3	3	40	60	100
4	23MEO14	Fire Safety Engineering	OE	3	0	0	3	3	40	60	100
5	23MEO15	Nano Technology	OE	3	0	0	3	3	40	60	100
6	23MEO16	Entrepreneurship Development	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT ARTIFICIAL INTELLIGENCE AND DATA SCIENCE											
1	23AD011	Introduction to Big Data	OE	2	0	2	4	3	50	50	100
2	23AD012	Principles of Data Science	OE	2	0	2	4	3	50	50	100
3	23AD013	Data Visualization and its Applications	OE	2	0	2	4	3	50	50	100
4	23AD014	Data Warehousing and Mining	OE	2	0	2	4	3	50	50	100
5	23AD015	Principles of Cyber Security	OE	2	0	2	4	3	50	50	100
OFFERED BY DEPARTMENT INFORMATION TECHNOLOGY											
1	23IT011	Basics of Java Programming	OE	2	0	2	4	3	50	50	100
2	23IT012	Ethical Hacking	OE	2	0	2	4	3	50	50	100
3	23IT013	E-Commerce and Applications	OE	2	0	2	4	3	50	50	100
4	23IT014	Basics of Android Application Development	OE	2	0	2	4	3	50	50	100
5	23IT015	Introduction to Web Design	OE	2	0	2	4	3	50	50	100
OFFERED BY DEPARTMENT OF PHARMACEUTICAL TECHNOLOGY											
1	23PYO11	Nutraceuticals	OE	3	0	0	3	3	40	60	100
2	23PYO12	IPR for Pharma Industry	OE	3	0	0	3	3	40	60	100
3	23PYO13	Pharmaceutical Nanotechnology	OE	3	0	0	3	3	40	60	100
4	23PYO14	Basics of Human Anatomy and physiology	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT BIOMEDICAL ENGINEERING											
1	23BMO11	Biomedical Instrumentation	OE	3	0	0	3	3	40	60	100
2	23BMO12	Medical Optics	OE	3	0	0	3	3	40	60	100
3	23BMO13	Biometric systems and their applications	OE	3	0	0	3	3	40	60	100
4	23BMO14	Healthcare Management systems	OE	3	0	0	3	3	40	60	100
5	23BMO15	IOT in Medicine	OE	3	0	0	3	3	40	60	100

23IPA11	INDUCTION PROGRAMME (Common to B.E./B.Tech. all Branches)	L T P C - - - 0

This is a mandatory **2 week programme** to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by **AICTE** with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity:

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts:

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later

(iii) Universal Human Values:

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity:

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules:

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People:

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area:

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations:

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities:

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop.

For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

REFERENCES:

1. Guide to Induction program from AICTE

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23ENT11	PROFESSIONAL ENGLISH – I (Common to B.E./B.Tech. all Branches)	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To improve the communicative competence of learners.
- To learn to use basic grammatical structures in suitable contexts.
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text.
- To help learners use language effectively in professional contexts.
- To develop learners' ability to read and write complex texts, summaries, articles, blogs,de initions, essays and user manuals.

UNIT-I **INTRODUCTION TO EFFECTIVE COMMUNICATION AND FUNDAMENTALS OF COMMUNICATION** **10**

Introduction to Effective Communication- Barriers of Communication, Seven C's of Effective Communication, Effective Listening, Effective Speaking, Excellence in Reading, Ways to Develop Language and Communication Skills.

Reading- Reading Brochures (Technical Context), Telephone Messages/ Social Media Messages Relevant to Technical Contexts and Emails.

Writing- Writing Emails / Letters Introducing Oneself.

Grammar- Present Tense (Simple and Progressive); Question Types: Wh/ Yes or No/ and Tags.

Vocabulary- Synonyms; One Word Substitution; Abbreviations & Acronyms (as Used in Technical Contexts)

UNIT-II **NARRATION AND SUMMATION** **9**

Reading - Reading Biographies, Travelogues, Newspaper Reports, Excerpts from Literature, and Travel & Technical Blogs.

Writing - Guided writing, Paragraph Writing, Short Report on an Event (Field Trip etc.)

Grammar - Past Tense (Simple); Subject-Verb Agreement; and Prepositions.

Vocabulary - Word Forms (Pre ixes& Suf ixes); Synonyms and Antonyms; Phrasal Verbs.

UNIT-III **DESCRIPTION OF A PROCESS / PRODUCT** **9**

Reading - Reading Advertisements, Gadget Reviews; User Manuals.

Writing - Writing De initions; Instructions; and Product /Process Description.

Grammar - Imperatives; Adjectives; Degrees of Comparison; Present & Past Perfect Tenses.

Vocabulary- Compound Nouns, Homonyms; and Homophones, Discourse Markers (Connectives & Sequence Words)

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UNIT-IV **CLASSIFICATION AND RECOMMENDATIONS** **9**

Reading - Newspaper Articles; Journal Reports –and Non Verbal Communication (Tables, Pie Charts etc...)
Writing - Note-making / Note-taking (*Study skills to be taught, not tested); Writing Recommendations; Transferring Information from Non Verbal (Chart , Graph etc, to Verbal Mode)
Grammar - Articles; Pronouns - Possessive & Relative Pronouns.
Vocabulary - Collocations; Fixed / Semi Fixed Expressions

UNIT-V **EXPRESSION** **8**

Reading - Reading Editorials; and Opinion Blogs;
Writing - Essay Writing (Descriptive or Narrative).
Grammar- Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences.
Vocabulary - Cause & Effect Expressions – Content vs. Function Words.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the Course the students will able to

CO1:	Use appropriate words in a professional context
CO2:	Gain understanding of basic grammatical structures and use them in right context
CO3:	Read and infer the denotative and connotative meanings of technical text
CO4:	Read and interpret information presented in tables, charts and other graphic forms
CO5:	Write de initions, descriptions, narrations and essays on various topics

TEXT BOOKS:

1. Department of English, Anna University, "English for Engineers & Technologists" Orient Blackswan Private Ltd, 2020.
2. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, & CO, Department of English, Anna University, "English for Science & Technology" Cambridge University Press, 2021.

REFERENCE BOOKS:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communication–Principles and Practices", Oxford Univ. Press, New Delhi, 2016.

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2. Lakshminarayanan, "A Course Book on Technical English", Scitech Publications (India) Pvt.Ltd. 2012.
3. Aysha Viswamohan, "English For Technical Communication (With CD)", Mcgraw HillEducation, ISBN : 0070264244, 2008.
4. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House, 2016.

E. RESOURCES:

- https://learnenglish.britishcouncil.org/

CO's-PO's MAPPING :

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	-	3
CO2	-	-	-	-	-	1	-	-	2	3	-	2
CO3	-	-	-	-	-	1	-	-	3	3	-	3
CO4	-	-	-	2	-	-	-	-	3	3	-	3
CO5	-	-	-	-	-	-	-	-	2	3	-	2
AVR	-	-	-	2	-	1	-	-	2	3	-	3

1- Low, 2- Medium, 3-High, "-" No Correlation

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23MAT11	MATRICES AND CALCULUS (Common to B.E./B.Tech. all Branches)	L T P C 3 1 0 4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications
- To familiarize the students with differential calculus
- To familiarize the student with functions of several variables. This is needed in many branches of engineering
- To make the students understand various techniques of integration
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications

UNIT-I **MATRICES** **9+3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications : Stretching of an elastic membrane.

UNIT-II **DIFFERENTIAL CALCULUS** **9+3**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules(sum, product, quotient, chain rules) - Implicit differentiation - Applications : Maxima and Minima of functions of one variable.

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

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT-IV **INTEGRAL CALCULUS** **9+3**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Improper integrals - Applications : Hydrostatic force and pressure, moments and centre of mass.

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UNIT-V **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 and triple integrals – Applications: Moments and centre of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to :

CO1: Use the matrix algebra methods for solving practical problems
CO2: Apply differential calculus tools in solving various application problems.
CO3: Use differential calculus ideas on several variable functions
CO4: Apply different methods of integration in solving practical problems
CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems

TEXT BOOKS :

1. James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2019. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5,7.1 - 7.4 and 7.8]
2. Grewal. B. S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018

REFERENCE BOOKS :

1. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2022
2. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2021
3. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016

CO's – PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	-	-	-	2	-	2	3
CO2	3	3	1	1	-	-	-	-	3	-	2	3
CO3	3	3	1	1	-	-	-	-	2	-	2	3
CO4	3	3	1	1	-	-	-	-	2	-	2	3
CO5	3	2	1	1	-	-	-	-	2	-	2	3
AVG	3	3	1	1	-	-	-	-	2	-	2	3

1- Low, 2- Medium , 3-High, "-" No Correlation

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23PHT11	ENGINEERING PHYSICS (Common to B.E./B. Tech. all branches)	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To make the students effectively achieve an understanding of mechanics
- Provide knowledge of elastic property, thermal property of materials and its applications
- Impart knowledge of laser and their applications
- Introduce the essential principles of iber optics and its applications
- Equipping the students to successfully understand the importance of quantum physics

UNIT-I **MECHANICS** **10**

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia – theorems of M – M.I of a diatomic molecule – torque – rotational dynamics of rigid bodies – rotational energy state of a rigid diatomic molecule – torsional pendulum – double pendulum

UNIT-II **PROPERTIES OF MATTER AND THERMAL PHYSICS** **10**

Elasticity- Hooke's law – stress – strain diagram – Poisson's ratio – Factors affecting elasticity –bending of beams-Bending moment equation – Depression of a cantilever–Young's modulus by uniform bending – I-shaped girders-Modes of heat transfer – thermal conductivity – Newton's law of cooling – Linear heat low – Lee's disc method – conduction through compound media (series and parallel)

UNIT-III **LASER** **9**

Lasers: Stimulated absorption – Spontaneous emission – Stimulated emission – Population inversion-Einstein's coef icients derivation and their relations – Pumping methods – Types of lasers – Nd:YAG, CO_2 laser, Semiconductor lasers (homojunction & heterojunction) – Industrial and Medical Applications of lasers

UNIT-IV **FIBER OPTICS** **8**

Principle and propagation of light in optical ibres – Numerical aperture and Acceptance angle – Types of optical ibres (material, refractive index, mode) – attenuation, dispersion, bending – Fiber optics communication system (qualitative) – Temperature and displacement sensors – iber optic endoscope

UNIT-V **QUANTUM PHYSICS** **8**

Photons and light waves – Electrons and matter waves – Compton effect: theory of scattering –Derivation and experimental veri ication – The Schrodinger equation (Time dependent and

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time independent forms) – particle in a one-dimensional rigid box for eigen value and eigen function – tunneling (qualitative) – scanning tunneling microscope

TOTAL: 45 PERIODS

COURSE OUTCOME:

At the end of the course the students will be able to

CO1: Understand the importance of mechanics.
CO2: Describe the Elastic property of solid materials and thermal conductivity of solids in industrial applications
CO3: Demonstrate a foundational knowledge in lasers
CO4: The students will get knowledge on iber optics
CO5: Understand the importance of quantum physics

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow, "An Introduction to Mechanics," McGraw Hill Education (IndianEdition), 2017
2. Arthur Beiser, Shobhit Mahajan, S.Rai Choudhury, "Concepts of Modern Physics," McGraw-Hill (Indian Edition), 2017

REFERENCE BOOKS:

1. K.Thyagarajan and A.Ghatak, "Lasers: Fundamentals and Applications," Laxmi Publications, (Indian Edition), 2023
2. D.Halliday, R.Resnick and J.Walker, "Principles of Physics," Wiley (Indian Edition), 2021
3. N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students," Springer-Verlag, 2012

CO's- PO's MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-
CO3	3	2	2	1	2	-	-	-	-	-	-	1
CO4	3	2	2	1	2	-	-	-	-	-	-	1
CO5	3	3	1	1	2	-	-	-	-	-	-	-
AVG	3	3	2	1	2	-	-	-	-	-	-	1

1- Low, 2- Medium , 3-High, "-" No Correlation

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23CYT11	ENGINEERING CHEMISTRY (Common to B.E./B. Tech. all branches)	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques
- To impart knowledge on the basic principles and preparatory methods of nanomaterials
- To introduce the basic concepts and applications of phase rule and composites
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices

UNIT-I **WATER AND ITS TREATMENT** **9**

Water: Sources and impurities, **Water quality parameters:** turbidity, pH, hardness, alkalinity, TDS, COD and BOD. **Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination)

UNIT-II **NANOCHEMISTRY** **9**

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: De inition, properties and uses of – nanoparticle, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, electrochemical deposition. **Applications** of nanomaterials with examples in medicine, agriculture, energy, electronics and catalysis.

UNIT-III **PHASE RULE AND COMPOSITES** **9**

Phase rule: Introduction, de inition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system – Pattinson's process.

Composites: Introduction: De inition & Need for composites; **Constitution**: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (iber, particulates, lakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites.

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UNIT-IV **FUELS AND COMBUSTION** **9**

Fuels: Introduction: Classi ication of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Solid biofuels, Compressed biogas, Power alcohol and biodiesel.**
Combustion of fuels: Introduction: Calori ic value - higher and lower calori ic values, Theoretical calculation of calori ic value; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT-V **ENERGY SOURCES AND STORAGE DEVICES** **9**

Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; **Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able

CO1: To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2: To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3: To apply the knowledge of phase rule and composites for material selection requirements.
CO4: To recommend suitable fuels for engineering processes and applications.
CO5: To recognize different forms of energy resources and apply them for suitable applications in energy sectors

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018
2. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018

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REFERENCE BOOKS:

1. Shashi Chawla, "A Text Book of Engineering Chemistry", Dhanpar Rai & Co (Pvt.) Ltd, New Delhi, 2011
2. O.G. Palanna, "Engineering Chemistry", McGraw Hill Education (India) Private Limited, 2nd Edition, 2017
3. Dr. A.Ravikrishnan, "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Limited, 23rd Edition, 2023

CO's- PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	1	3	3	-	-	-	-	-
CO2	3	2	1	1	2	2	-	-	-	-	-	1
CO3	3	3	1	1	1	1	-	-	-	-	-	-
CO4	3	2	1	1	1	1	-	-	-	-	-	-
CO5	3	2	2	1	2	2	2	-	-	-	-	-
AVG	3	2	2	1	1	2	3	-	-	-	-	1

1- Low, 2- Medium , 3-High, "-" No Correlation

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23CST11	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to: B.E. / B.Tech. all Branches)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To solve problems using computational thinking methods using pseudo code and flowchart
- To understand the fundamentals of algorithmic problem solving basics and strategies
- To define variables data types and error messages
- To learn to solve problems using Python conditionals loops lists tuples and dictionaries to represent complex data
- To understand the functions modules and do input/output with files in Python

UNIT-I **COMPUTATIONAL THINKING** **8**

Introduction - Problem solving and Decomposition - Abstraction - Notations Pseudo code - Flow chart - Programming language

UNIT-II **ALGORITHMIC PROBLEM SOLVING** **8**

Algorithm Implementation - Top down design - Simple strategies for developing algorithms - Iteration - Recursion - Fundamental algorithms - Anticipating and Dealing with Errors

UNIT-III **BASICS BUILDING BLOCKS OF PYTHON** **9**

Variables - Immutable variables - Data types - Operators - Python Reserved Words - Understanding error messages

UNIT-IV **CONTROL STATEMENTS AND STRUCTURED TYPES** **10**

Control Flow - Indenting - if Statement - while Loop - break and continue - for Loop - String - Lists - Tuples - Sets - Dictionaries

UNIT-V **FUNCTIONS, MODULES AND FILES** **10**

Definition - Hiding redundancy - Arguments and return values - Variable Number of Arguments - Scope - Passing Functions to a Function - Mapping Functions in a Dictionary - Lambda function – Recursive Functions - Modules: Standard Modules - OS and SYS modules - User defined Modules - Importing modules – Writing into a File - Reading from a File - File Methods

TOTAL : 45 PERIODS

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BoS/CSE&IT

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Develop algorithmic solutions for simple computational problems to develop and execute simple Python programs.

CO2 : Write the Algorithms for problem solving basics and strategies to solve complex problems

CO3 : Compose simple Python programs using to illustrate variables data types and error messages.

CO4 : Represent compound data using Python conditionals loops lists tuples dictionaries for solving problems

CO5 : Create functions modules read and write data from/to files in Python programs.

TEXT BOOKS:

1. R. G. Dromey "How to Solve it by Computer", Pearson Education., 2015
2. Charles Dierbach "Introduction to Computer Science using Python: A Computational Problem- Solving Focus", Wiley India., 2015

REFERENCE BOOKS:

1. John V. Guttag "Introduction to Computation and Programming using Python", The MIT press. 2021 (3rd Edition).
2. Paul Gries, Jennifer Campbell, Jason Montojo "Practical Programming: An Introduction to Computer Science using Python 3", Pragmatic Programmers., 2013 , Second edition
3. Robert Sedgewick, Kevin Wayne, Robert Dondero "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India., 2016
4. Karl Beecher "Computational Thinking - A beginner's guide to problem solving and Programming", BCS Learning &Development., 2017

E-RESOURCES:

1. http://www.flowgorithm.org/
2. https://www.python.org/
3. https://nptel.ac.in/courses/106104074

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3
CO2	2	3	3	3	2	-	-	-	-	-	2	-	3	3	3
CO3	2	2	-	2	2	-	-	-	-	-	1	-	3	3	3
CO4	1	2	-	-	1	-	-	-	-	-	1	-	2	3	3
CO5	2	2	-	-	2	-	-	-	-	-	1	2	2	3	3
AVG	**2**	**3**	**3**	**3**	**2**	-	-	-	-	-	**2**	**2**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS/CSE&IT

23TAT11	HERITAGE OF TAMILS (Common to B.E./B. Tech. all branches)	L T P C 1 0 0 1

COURSE OBJECTIVES:

- To understand the Sangam and modern literature of Tamil
- To learn the heritage of Tamil culture
- To recognize the various art forms of Tamils
- To explain the Thinai concept of Tamils
- To realize the contribution of Tamils to Indian national movement and Indian culture

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 Modernliterature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

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

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

UNIT-III **FOLK AND MARTIAL ARTS** **3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam,Valari, Tiger dance - Sports and Games of Tamils.

UNIT-IV **THINAI CONCEPTS 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 In luence of Tamils over the otherparts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15 PERIODS

Chairman
BoS / S&H

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: Gain knowledge about various literatures of Tamil
CO2: Learn the uniqueness of Tamil cultural heritage
CO3: Find various art forms of Tamil Nadu
CO4: Understand the Thinai concepts in Tamil
CO5: Distinguish the contribution of Tamils to Indian national movement and Indian culture

E- RESOURCES:

1. https://www.tamilvu.org/

CO's –PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	1	-	1	-	-
CO2	-	-	-	-	-	1	1	1	-	1	-	-
CO3	-	-	-	-	-	1	1	1	-	1	-	-
CO4	-	-	-	-	-	1	1	1	-	1	-	-
CO5	-	-	-	-	-	1	1	1	-	1	-	-
AVG	-	-	-	-	-	1	1	1	-	1	-	-

1- Low, 2- Medium , 3-High, "-" No Correlation

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23TAT11 **தமிழர் மரபு** **L T P C**
1 0 0 1

(B.E./B.Tech- அனைத்து பாடப்பிரிவுகளுக்கும் பொதுவானது)

பாடநெறி நோக்கங்கள்:

- தமிழின் இலக்கியங்கள் மற்றும் நவீன இலக்கியங்களைப் புரிந்துகொள்ளுதல்
- தமிழ் கலாச்சார பாரம்பரியத்தைக் கற்றுக்கொள்ளுதல்
- தமிழர்களின் பல்வேறு கலைவடிவங்களைக் கண்டறிதல்
- தமிழர்களின் திணைக்கோட்பாடுகளை விளக்குதல்
- இந்திய சுதந்திர போராட்ட இயக்கங்களுக்கும் இந்திய கலாச்சாரத்திற்குமான தமிழர்களின் பங்களிப்பை உணர்தல்

அலகு - I **மொழி மற்றும் இலக்கியம்** **3**

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

அலகு - II **மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை** **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப்பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு - III **நாட்டப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள்** **3**

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

அலகு - IV **தமிழர்களின் திணைக் கோட்பாடுகள்** **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவு, கல்வியும் - சங்ககால நகரங்களும் துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

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அலகு - V **இந்திய தேசிய இயக்கம் மற்றும்** **3**

இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிற்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

மொத்தம்: 15 பாடவேளைகள்

பாடநெறி முடிவுகள்:

இப்பாடத்தைப் படிப்பதின் முடிவில் மாணவர்கள்

CO1: தமிழின் பல்வேறு இலக்கியங்களைப் பற்றிய அறிவைப் பெறுவார்கள்
CO2: தமிழ் கலாச்சார பாரம்பரியத்தின் தனித்தன்மையைக் கற்றுக்கொள்வார்கள்
CO3: தமிழகத்தின் பல்வேறு கலைவடிவங்களைக் கண்டறிவார்கள்
CO4: தமிழர்களின் திணைக்கோட்பாடுகளை அறிந்துகொள்வார்கள்
CO5: தமிழ் சுதந்திரப்போராட்ட வீரர்கள் மற்றும் தமிழ் கலாச்சாரத்தை இந்தியாவின் மற்ற பகுதியுடன் ஒப்பிடும் திறனைப் பெறுவார்கள்

மின் -ஆதாரங்கள்:

1. https://www.tamilvu.org/

CO's –PO's விவரணையாக்கம்:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	1	-	1	-	-
CO2	-	-	-	-	-	1	1	1	-	1	-	-
CO3	-	-	-	-	-	1	1	1	-	1	-	-
CO4	-	-	-	-	-	1	1	1	-	1	-	-
CO5	-	-	-	-	-	1	1	1	-	1	-	-
AVG	-	-	-	-	-	1	1	1	-	1	-	-

1- Low, 2- Medium , 3-High, "-" No Correlation

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		L	T	P	C
23CSL11	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	0	0	4	2

(Common to: B.E. / B.Tech. all Branches)

COURSE OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python

LIST OF EXPERIMENTS

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

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/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL : 60 PERIODS

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BoS/CSE&IT

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Develop algorithmic solutions to simple computational problems

CO2 : Develop and execute simple Python programs.

CO3 : Implement programs in Python using conditionals and loops for solving problems.

CO4 : Deploy functions to decompose a Python program.

CO5 : Process compound data using Python data structures and Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

E-RESOURCES:

1. http://www.flowgorithm.org/
2. https://www.python.org/
3. https://nptel.ac.in/courses/106104074

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	-	2	-	3	3	
CO3	2	2	-	2	2	-	-	-	-	-	1	-	3	3	3
CO4	1	2	-	-	1	-	-	-	-	-	1	-	2	3	3
CO5	2	2	-	-	2	-	-	-	-	-	1	-	2	3	3
AVG	**2**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS/CSE& IT

23PCL11	PHYSICS AND CHEMISTRY LABORATORY (Common to B.E./B. Tech. all branches)	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY
(Any Seven Experiments)

COURSE OBJECTIVES:

- Determination of the physical parameters such as young's modulus by Uniform bending method, Non-Uniform bending method, Simple harmonic oscillations of cantilever and rigidity modulus of wire
- To impart knowledge in the determination of the thermal conductivity of a bad conductor by Lee's Disc method and band gap of a semiconductor
- Determination of the wavelength of the laser using grating, numerical aperture and acceptance angle in an optical iber and width of the groove in an compact disc by using laser
- Determination of the velocity of sound and compressibility of liquids by using ultrasonic interferometer
- Knowledge on the frequency of alternating current using electrically vibrating tuning fork by using Melde's apparatus

LIST OF EXPERIMENTS

1. Determination of Young's modulus by Uniform bending method
2. Determination of Young's modulus by non-uniform bending method
3. Simple harmonic oscillations of cantilever
4. Determination of rigidity modulus of wire and moment of inertia of regular objects – Torsion pendulum
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method
6. Determination of band gap of a semiconductor
7. Determination of the wavelength of the laser using grating
8. a) Determination of numerical aperture and acceptance angle in an optical iber
   b) Determination of width of the groove in an compact disc by using laser
9. Determination of the velocity of sound and compressibility of liquids by using ultrasonic interferometer
10. Determination of the frequency of alternating current using electrically vibrating tuning fork -Melde's apparatus

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Experiment and determine the physical characteristics of given solid materials using Young's modulus-Uniform bending method, non-uniform bending method, cantilever method and Torsion Pendulum.

CO2: Experiment and determine the thermal conductivity of a bad conductor using Lee's Disc method and band gap energy of a given semiconducting material using Zener diode.

CO3: Experiment and determine the optical property of light sources, acceptance angle of optical iber and width of the groove in an compact disc using Laser.

CO4: Experiment and determine the velocity of ultrasonic waves using ultrasonic interferometer.

CO5: Experiment and determine the frequency of alternating current using electrically vibrating tuning fork by using Melde's apparatus

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TEXT BOOKS:

1. Dr. P. Mani, Engineering Physics Practicals, Dhanam Publications (2022)

CO's – PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	-	-	-	-	-	-	-
CO2	3	3	1	1	-	-	-	-	-	-	-	-
CO3	3	3	1	1	-	-	-	-	-	-	-	-
CO4	3	3	1	1	-	-	-	-	-	-	-	-
CO5	3	3	1	1	-	-	-	-	-	-	-	-
AVG	3	3	1	1	-	-	-	-	-	-	-	-

CHEMISTRY LABORATORY

(Any Seven Experiments)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as acidity, alkalinity.
- To acquire the knowledge in total hardness and dissolved oxygen and its impacts in industries through experiments
- To understand the impacts of chlorine in water sample through volumetric analysis.
- To induce the students to familiarize with electroanalytical techniques in the determination of impurities in aqueous solutions.
- To determine the amount of metal ions through spectroscopic techniques.

LIST OF EXPERIMENTS

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
2. Determination of types and amount of alkalinity in a water sample
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Conductometric titration of barium chloride against sodium sulphate (precipitation titration).
9. Estimation of iron content of the given solution using potentiometer.
10. Estimation of sodium /potassium present in water using a lame photometer.

TOTAL: 30 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Analyse the quality of water samples with respect to their acidity and alkalinity of water samples

CO2: Examine the water quality parameters like total hardness and DO with volumetric analysis.

CO3: Learn the permissible limit of chlorine in the given water sample

CO4: Analyse the impurities in solution by electro analytical techniques quantitatively

CO5: Determine the amount of metal ions through spectroscopic techniques.

CO's – PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	3	3	1	-	-	-	1
CO2	3	2	2	-	-	3	3	1	-	-	-	1
CO3	3	2	1	-	-	3	3	1	-	-	-	1
CO4	3	2	2	-	1	2	1	-	-	-	-	-
CO5	3	2	1	-	1	2	1	-	-	-	-	-
Avg.	3	2	1	-	1	3	2	1	-	-	-	1

TEXT BOOKS:

1. "Vogel's Textbook of Quantitative Chemical Analysis", (8^{th} Edition, 2014)
2. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbookof Quantitative Chemical Analysis", (2009)

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BoS / S&H

23ENL11	ENGLISH LABORATORY (Common to B.E./B.Tech. all Branches)	L T P C 0 0 2 1

COURSE OBJECTIVES:

- To improve the communicative competence of learners.
- To help learners use language effectively in academic /work contexts.
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities those are relevant to authentic contexts.
- To use language ef iciently in expressing their opinions via various media.

UNIT-I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening- Listening for General Information-Speci ic Details- Conversation: Introduction toClassmates - Audio / Video (Formal & Informal); Telephone Conversation; Listening to Voicemail & Messages; Listening and Filling a Form.
Speaking- Making Telephone Calls- Self Introduction; Introducing a Friend; - Politeness Strategies- Making Polite Requests, Making Polite Offers, Replying to Polite Requests and Offers- Understanding Basic Instructions (Filling out a Bank Application for Example).

UNIT-II NARRATION AND SUMMATION 6

Listening - Listening to Podcasts, Anecdotes / Stories / Event Narration; Documentaries and Interviews with Celebrities.
Speaking - Narrating Personal Experiences / Events-Talking about Current and Temporary Situations & Permanent and Regular Situations - Describing Experiences and Feelings- Engaging in Small Talk- Describing Requirements and Abilities.

UNIT-III DESCRIPTION OF A PROCESS / PRODUCT 6

Listening - Listen to Product and Process Descriptions; A Classroom Lecture; and Advertisements about Products.
Speaking - Picture Description- Describing Locations in Workplaces- Giving Instruction to Use the Product- Explaining Uses and Purposes- Presenting a Product- Describing Shapes and Sizes and Weights- Talking about Quantities (Large & Small)- Talking about Precautions.

UNIT-IV CLASSIFICATION AND RECOMMENDATIONS 6

Listening – Listening to Technology, Entertainment and Design (TED) Talks; Listening to Lectures - and Educational Videos.
Speaking – Small Talk; Discussing and Making Plans-Talking about Tasks-Talking about Progress- Talking about Positions and Directions of Movement- Talking about Travel Preparations- Talking about Transportation.

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UNIT-V **EXPRESSION** **6**

Listening - Listening to Debates/ Discussions; Different Viewpoints on an Issue; and Panel Discussions.

Speaking - Making Predictions- Talking about a Given Topic-Giving Opinions- Understandinga Website- Describing Processes.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able

CO1: To listen to and understand general and complex academic information
CO2: To listen to and understand different points of view in a discussion
CO3: To speak luently and accurately in formal and informal communicative contexts
CO4: To describe products and processes and explain their uses clearly as well as accurately
CO5: To express their opinions effectively in both formal and informal discussions

E. RESOURCES:

- https://www.ted.com/about/programs-initiatives/ted-talks-education
- https://learnenglish.britishcouncil.org/

CO's & PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	1	2	3	-	2
CO4	-	-	-	-	-	-	-	-	2	3	-	2
CO5	-	-	-	-	-	-	-	1	3	3	-	2
AVR	-	-	-	-	-	-	-	1	3	3	-	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS / S&H

23ENT21	PROFESSIONAL ENGLISH – II (Common to B.E./B.Tech. all Branches)	L T P C 2 0 0 2

COURSE OBJECTIVES:

- To engage learners in meaningful language activities to improve their reading and writing skills.
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing.
- To develop analytical thinking skills for problem solving in communicative contexts.
- To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT-I **MAKING COMPARISONS** **6**

Reading - Reading Advertisements, User Manuals, Brochures Emails.

Writing - Professional Emails, Email Etiquette - Compare and Contrast Essay.
Grammar - Mixed Tenses, Prepositional Phrase.

UNIT-II **EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING** **6**

Reading - Reading Longer Technical Texts– Cause and Effect Essays, and Letters / Emails of Complaint.
Writing - Writing Responses to Complaints.
Grammar - Active Passive Voice Transformations, In initive and Gerunds.

UNIT-III **PROBLEM SOLVING** **6**

Reading - Case Studies, Excerpts from Literary Texts, News Reports etc.
Writing - Letter to the Editor, Checklists, Problem Solution Essay / Argumentative Essay.
Grammar - Error Correction; If Conditional Sentences.

UNIT-IV **CLASSIFICATION AND RECOMMENDATIONS** **6**

Reading - Newspaper Articles.
Writing - Recommendations, Transcoding, Accident Report, Survey Report
Grammar - Reported Speech, Modals.
Vocabulary - Conjunctions- Use of Prepositions.

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UNIT-V **EXPRESSION** **6**

Reading - Company Pro iles, Statement of Purpose, (SOP), An Excerpt of Interview with Professionals.
Writing - Job / Internship Application – Cover Letter & Resume.
Grammar - Numerical Adjectives, Relative Clauses.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the Course the students will able to

CO1:	Compare and contrast products and ideas in technical texts.
CO2:	Identify and report cause and effects in events, industrial processes through technical texts
CO3:	Analyse problems in order to arrive at feasible solutions and communicate them in the written format
CO4:	Present their ideas and opinions in a planned and logical manner
CO5:	Draft effective resumes in the context of job search.

TEXT BOOKS:

1. Department of English, Anna University, "English for Engineers & Technologists" Orient Blackswan Private Ltd, 2020.
2. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, & CO, Department of English, Anna University, "English for Science & Technology" Cambridge University Press, 2021.

REFERENCE BOOKS:

1. Raman, Meenakshi, Sharma & Sangeeta, "Professional English", Oxford University Press, New Delhi, 2019.
2. Dr. V. Chellammal, "Learning to Communicate", Allied Publishers, New Delhi, 2003
3. V.N. Arora and Laxmi Chandra, "Improve Your Writing", Oxford University Press, NewDelhi, 2001.

E. RESOURCES:

- https://learnenglish.britishcouncil.org/

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CO'S-PO'S MAPPING :

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	-	-	-	-	1	2	3	-	2
CO2	-	-	-	-	-	-	1	-	3	3	-	3
CO3	-	1	1	-	-	-	-	-	3	3	-	3
CO4	-	-	-	-	-	-	-	-	2	3	-	2
CO5	-	-	-	-	-	-	-	-	2	3	-	2
AVG	-	1	1	-	-	-	1	1	2	3	-	2

1. **Low, 2- Medium, 3-High, "-" No Correlation**

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BoS / S&H

23MAT21	NUMERICAL METHODS AND STATISTICS (Common to B.E./B.Tech. all Branches)	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations
- To introduce the numerical techniques of interpolation in various intervals and differentiation and integration in engineering and technology
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of engineering and statistical quality control

UNIT-I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting-Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT-II INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules

UNIT-III NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

UNIT-IV TESTING OF HYPOTHESIS 9+3

Sampling distributions - Tests for single mean, proportion and difference of means (Large andsmall samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes

UNIT-V DESIGN OF EXPERIMENTS 9+3

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

TOTAL : 60 PERIODS

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BoS / S&H

COURSE OUTCOMES:

At the end of the Course the students will be able to

CO1 : Apply the numerical techniques of interpolation in various intervals and differentiation and integration for engineering problems

CO2 : Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations

CO3 : Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications

CO4 : Apply the concept of testing of hypothesis for small and large samples in real life problems

CO5 : Apply the basic concepts of classifications of design of experiments in the field of agriculture

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2023
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2019

REFERENCE BOOKS:

1. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020
2. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage
4. Learning, New Delhi, 8th Edition, 2014
5 Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, India, 2022

CO's – PO's MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	1	-	-	-	2	-	2	3
CO2	3	3	1	1	1	-	-	-	2	-	2	2
CO3	3	3	1	1	1	-	-	-	2	-	2	3
CO4	3	3	1	1	1	-	-	-	2	-	2	3
CO5	3	2	1	1	1	-	-	-	2	-	3	3
AVG	3	3	1	1	1	-	-	-	2	-	2	3

1- **Low, 2- Medium , 3-High, "-" No Correlation**

Chairman
BoS / S&H

23PHT23	PHYSICS FOR ELECTRONICS ENGINEERING (for B.E. / B.TECH - ECE, EEE and PT)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the electrical properties of materials
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications
- To understand the theory and applications of dielectric materials
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To provide the students a sound platform towards learning about new engineering materials and their applications

UNIT-I **ELECTRICAL PROPERTIES OF MATERIALS** 9

Classical free electron theory – Expression for electrical conductivity – Thermal conductivity, expression – Wiedemann-Franz law – Success and failures – electrons in metals – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids.

UNIT-II **SEMICONDUCTING MATERIALS** 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in N-type & P-type semiconductors – variation of Fermi level with temperature and impurity concentration –Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT-III **DIELECTRIC MATERIALS** 9

Dielectrics – Dielectric constant – Polarization – Displacement vector – Electric susceptibility – Types of polarization mechanisms: Electronic, ionic, orientational and space-charge – Frequency and temperature dependence – Internal ield – Clausius-Mosotti relation – Dielectric loss – Dielectric breakdown – Ferroelectric materials.

UNIT-IV **OPTICAL PROPERTIES OF MATERIALS** 9

Classi ication of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode – OLED

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UNIT-V **NEW ENGINEERING MATERIALS** **9**

Ceramics – types and applications – Composites: classi ication, role of matrix and reinforcement – processing of ibre reinforced plastics and ibre reinforced metals – Metallic glasses: Properties, preparation and applications – Shape memory alloys: Characteristics and applications – Carbon nanotubes: Properties and applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Gain knowledge on the electrical properties of materials and their applications
CO2:	Understand clearly of semiconductor physics and functioning of semiconductor devices
CO3:	Get knowledge on theories and applications of dielectric materials
CO4:	Understand the optical properties of materials and working principles of various optical devices
CO5:	The students will understand the basics of ceramics, composites and nanomaterials

TEXT BOOKS:

1. S.O. Kasap, "Principles of Electronic Materials and Devices", McGraw Hill Education (Indian Edition), 2020.
2. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2020.

REFERENCE BOOKS:

1. Laszlo Solymar, Walsh, Donald, Syms and R.A. Richard, "Electrical Properties of Materials", Oxford Univ. Press (Indian Edition) 2015.
2. Jasprit Singh, "Semiconductor Optoelectronics: Physics and Technology", McGraw-Hill Education (Indian Edition), 2019.
3. Charles Kittel, "Introduction to Solid State Physics", Wiley India Edition, 2022.

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CO's –PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-
CO5	3	1	1	-	-	-	-	-	-	-	-	-
AVG	3	2	1	-	-	-	-	-	-	-	-	-

1- Low, 2- Medium , 3-High, "-" No Correlation

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BoS / S&H

23EET21	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To learn the basic concepts and behavior of DC and AC circuits.
- To apply the network theorems concepts in DC and AC circuits.
- To analyze the transient and steady state response of RL, RC, RLC circuits.
- To analyze the concept of Resonance and coupling circuits.
- To understand the concept of three phase circuits and power measurement.

UNIT-I **BASIC CIRCUIT ANALYSIS** **13**

Basic components of electric circuits, Charge, Current, Voltage and Power, Voltage and current sources, Ohms law, Kirchhoff's laws, Series and parallel connected Independent sources, Resistors in series and parallel, Voltage division and Current division rule, Mesh current and node voltage methods of analysis DC and AC circuits.

UNIT-II **NETWORK REDUCTION AND THEOREMS** **13**

Network Reduction: Source transformation, Star delta conversion. Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem to DC and AC circuits.

UNIT-III **TRANSIENT RESPONSE ANALYSIS** **12**

Laplace transforms and inverse laplace transforms, Standard test signals, Transient response of RL, RC and RLC circuits using laplace transform for source free, Step input and Sinusoidal input.

UNIT-IV **RESONANCE AND COUPLED CIRCUITS** **11**

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

UNIT-V **THREE PHASE CIRCUITS** **11**

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, Balanced and unbalanced, Phasor diagram of voltages and currents, Power measurement in three phase circuits, Power factor calculations.

TOTAL: 60 PERIODS

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COURSE OUTCOMES:

At the end of this course the students will be able to

CO1	Explain circuit's behavior using circuit laws and analyze the mesh analysis and nodal analysis.
CO2	Apply the network theorems to determine behavior of the given DC and AC circuits.
CO3	Analyze steady state response and transient response for any RC, RL and RLC circuits.
CO4	Analyze the frequency response of series and parallel resonance circuits and coupled circuits.
CO5	Explain the concepts of three phase circuits and power measurements.

TEXT BOOKS:

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, 9thedition, New Delhi, 2020.
2. Joseph Edminister and MahmoodNahvi, —Electric Circuits, Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.
3. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", McGraw- Hill, 2nd Edition, 2003.

REFERENCE BOOKS:

1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7thEdition, 2009.
2. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013
3. John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The McGraw Hill companies, 2nd Edition, 2011

E- RESOURCES:

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	1	-	-	3	2	1
CO2	3	3	2	2	-	-	-	-	-	1	-	-	3	3	2
CO3	3	3	3	3	-	-	-	-	-	1	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	1	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	1	-	-	3	3	3
AVG	3	3	2	2	-	-	-	-	-	1	-	-	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / EEE

		L	T	P	C
23MET21	**ENGINEERING GRAPHICS** (Common to: B.E./B.Tech. all Branches)	2	0	4	4

Course Objectives:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing projection of points, lines and plane surface.
- Drawingprojection of solids and freehand sketching.
- Drawing of sectioned solids and development of surfaces
- Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

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

UNIT-I PLANE CURVES **5+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT-II PROJECTION OF POINTS, LINES AND PLANE SURFACE **6+12**

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

UNIT-III PROJECTION OF SOLIDS AND FREEHAND SKETCHING **6+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Orthographic projection- Freehand sketching of multiple views from pictorial views of objects.

UNIT-IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **7+12**

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

UNIT-V ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+12**

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

TOTAL : 90 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Construct the conic curves, involutes and cycloid

CO2: Solve practical problems involving projection of lines, Planes.

CO3: DrawProjection of solids and can draw freehand sketch.

CO4: Draw projection of sectioned solids and development of surfaces

CO5: Draw theisometric and perspective projections.

TEXT BOOKS:

1. K Venugopal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2013.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

REFERENCE BOOKS:

1. BasantAgarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edit ion, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/102/112102304/
2. https://onlinecourses.nptel.ac.in/noc20_me79/preview
3. https://www.youtube.com/watch?v=ANEvQyt3PnU

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
Avg	**3**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**2**	**2**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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	BASIC CIVIL AND MECHANICAL ENGINEERING (for B.E.-EEE)	L	T	P	C
23MET22		3	0	0	3

Course Objectives:

- To provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.
- To help students acquire knowledge in the basics of surveying and the materials used for Construction.
- To provide an insight to the essentials of components of a building and the infrastructurefacilities.
- To provide the students an illustration of the significance of the Mechanical Engineering Profession in satisfying the societal needs &to distinguish the components and working principle of IC engines.
- To explain the components of power plant units.

PART A OVERVIEW OF CIVIL ENGINEERING

UNIT-I INTRODUCTION OF CIVIL ENGINEERING 5

Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation – terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial buildings.

UNIT-II SURVEYING AND CIVIL ENGINEERING MATERIALS 10

Surveying: Objects – Classification – Principles –Leveling – Determination of areas– Contours.**Civil Engineering Materials:** Bricks – Stones – Sand – Cement – Concrete – Steel - Timber – Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Pre-fabricated Building component (brief discussion only)

UNIT-III BUILDING COMPONENTS AND INFRASTRUCTURE 8

Building plans – Setting out of a Building - Foundations: Types of foundations - Bearing capacity and settlement – Brick masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring – Plastering. Types of Bridges and Dams –- Introduction to Highways and Railways.

PART B OVERVIEW OF MECHANICAL ENGINEERING

UNIT-IV INTRODUCTION OF MECHANICAL ENGINEERING & INTERNAL COMBUSTION ENGINES 12

Overview of Mechanical Engineering - Mechanical Engineering Contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering – Manufacturing, Automation, Automobile and Energy Engineering - Interdisciplinary concepts in Mechanical Engineering.

Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Concept of hybrid engines. Industrial safety practices and protective devices.

UNIT-V POWER PLANTS 10

Classification of Power Plants- Working principle of Steam, Diesel, Hydro-electric and Nuclear Power plants–Working principle of Turbines and Types-Steam, Gas Turbine.

TOTAL: 45 PERIODS

COURSE OUTCOME

The student will be able to

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CO's	OUTCOME
CO1	Understand the Civil Engineering components of Projects.
CO2	Summarize the planning of building, infrastructure and working of Machineries
CO3	Apply the knowledge gained in respective discipline.
CO4	Understand the Mechanical Engineering components Demonstrate working principles of petrol, diesel and hybrid engine.
CO5	Identify the components used in power plants.

TEXT BOOKS:

1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018.
2. K Venugopal, V.Prabhu raja, G. Sreekanjana, "Basic Civil and Mechanical Engineering" Anuradha Publications; Third Edition, 2019.
3. Anup Goel , Dipak ugale , " Basic Civil and Mechanical Engineering, Technical Publications, edition, 2019.

REFERENCE BOOKS:

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2018.
2. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd, 2013.
3. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
4. Shantha Kumar SRJ., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/105/106/105106201/
2. https://onlinecourses.nptel.ac.in/noc24_me104/preview

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	1	-	-	2	2	1	2	-	1	-	-	-
CO2	2	-	-	-	-	-	3	2	2	2	-	2	-	-	-
CO3	2	-	-	-	-	-	3	2	2	2	-	2	-	-	-
CO4	2	-	-	-	-	-	2	2	2	2	-	2	-	-	-
CO5	2	-	-	-	-	-	2	2	2	2	-	2	-	-	-
Avg	2	-	-	1	-	-	2.4	2	1.8	2	-	1.8	-	-	-

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23TAT21	TAMILS AND TECHNOLOGY (Common to B.E./B. Tech. all branches)	L T P C 1 0 0 1

COURSE OBJECTIVES:

- To understand about weaving and ceramic technology of Tamils
- To compare the design and constructive technology of Cheras, Cholas, Pallavas and Nayakkars
- To gain knowledge in various manufacturing technology of Tamils
- To analyse the agriculture and ishery knowledge of Tamils
- To learn about scienti ic Tamil and its usage in online platforms

UNIT-I **WEAVING AND CERAMIC TECHNOLOGY** **3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graf iti 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)- Thirumalai Nayakar 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, Signi icance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Speci ic Society

UNIT-V **SCIENTIFIC TAMIL & TAMIL COMPUTING** **3**

Development of Scienti ic 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

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COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: Relate the weaving ceramic technology of Tamils
CO2: Understand the knowledge of Tamils in design and construction technology
CO3: Recognize the manufacturing technology knowledge of Tamils
CO4: Criticize the agriculture and ishery knowledge of Tamils
CO5: Apply scienti ic Tamil in Various online platforms

E- RESOURCES:

1. https://www.tamilvu.org/
2. https://sorkuvai.com/

CO's –PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	1	1	1	1	1	-	1
CO2	2	-	-	-	-	2	2	2	2	2	-	2
CO3	2	-	-	-	-	2	2	2	2	2	-	2
CO4	1	-	-	-	-	1	1	1	1	1	-	1
CO5	2	-	-	-	-	2	2	2	2	2	-	2
AVG	2	-	-	-	-	2	2	2	2	2	-	2

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23TAT21 **தமிழரும் தொழில்நுட்பமும்** **L T P C**
1 0 0 1

(B.E./B.Tech- அனைத்து பாடப்பிரிவுகளுக்கும் பொதுவானது)

பாடநெறி நோக்கங்கள்:

- நெசவு மற்றும் பானைத்தொழில்நுட்பத்தைப் புரிந்து கொள்ளுதல்
- சேர, சோழ, பல்லவ மற்றும் நாயக்கர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பத்தை ஒப்பிடுதல்
- தமிழர்களின் பல்வேறு உற்பத்தி தொழில்நுட்பத்தைப் பற்றிய அறிவைப் பெறுதல்
- தமிழர்களின் வேளாண்மை மற்றும் கடல்சார் அறிவைப் பெற்றுக்கொள்ளுதல்
- அறிவியல் தமிழையும் அதன் இணையப்பயன்பாட்டையும் கற்றல்

அலகு - I **நெசவு மற்றும் கட்டிடத் தொழில்நுட்பம்** **3**

சங்க காலத்தில் நெசவுத்தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்சங்க காலத்தில் நெசவுத்தொழில் - 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 கட்டுமானப்பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும் கோவில்களும் - சோழர் காலத்து 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 தொழில்நுட்பம்** **3**

கப்பல் காட்டும் 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

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அலகு - IV **வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம்** **3**

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

அலகு - V **அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்** **3**

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

மொத்தம்: 15 பாடவேளைகள்

பாடநெறி முடிவுகள்:

இப்பாடத்தைப் படிப்பதின் முடிவில் மாணவர்கள்

CO1: நெசவு மற்றும் பானைத்தொழில்நுட்பத்தை பற்றிப் புரிந்துகொள்வார்கள்
CO2: வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பத்தில் தமிழர்களின் அறிவைப் பெறுவார்கள்
CO3: தமிழர்களின் உற்பத்தி தொழில்நுட்பத்தை கண்டறிவார்கள்
CO4: தமிழர்களின் வேளாண்மை மற்றும் கடல்சார் அறிவைக் குறித்து விவாதிப்பார்கள்.
CO5: பல்வேறு இணையப் பயன்பாடுகளில் அறிவியல் தமிழைப் பயன்படுத்திப்பார்ப்பார்கள்

மின் -ஆதாரங்கள்:

1. https://www.tamilvu.org/
2. https://sorkuvai.com/

CO's –PO's விவரணையாக்கம்:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	1	1	1	1	1	-	1
CO2	2	-	-	-	-	2	2	2	2	2	-	2
CO3	2	-	-	-	-	2	2	2	2	2	-	2
CO4	1	-	-	-	-	1	1	1	1	1	-	1
CO5	2	-	-	-	-	2	2	2	2	2	-	2
AVG	2	-	-	-	-	2	2	2	2	2	-	2

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23EEL21	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To simulate various electric circuits using Pspice/ Matlab/e-Sim / Scilab.
- To gain practical experience on electric circuits and verification of theorems.

LIST OF EXPERIMENTS

1. Simulation and experimental verification of series and parallel electric circuits using fundamental laws.
2. Simulation and experimental verification of electrical circuit problems using Thevenin's Theorem.
3. Simulation and experimental verification of electrical circuit problems using Norton's Theorem.
4. Simulation and experimental verification of electrical circuit problems using Superposition Theorem.
5. Simulation and experimental verification of electrical circuit problems using Maximum power transfer Theorem.
6. Simulation and Experimental validation of RL, RC and RLC circuit transients.
7. Simulation and Experimental validation of frequency response of RLC circuits.
8. Design and implementation of series and parallel resonance circuits.
9. Simulation and experimental verification of three phase balanced and unbalanced star, delta networks circuit (Power and Power factor calculations).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1	Simulate and verify the electric circuits using fundamental laws.
CO2	Simulate and verify the electric circuits using various theorems.
CO3	Simulate and validate the transient response of RL, RC and RLC circuits.
CO4	Design and implement the series and parallel resonance circuits.
CO5	Simulate and verify the three phase star and delta networks circuit.

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REFERENCE BOOKS:

1. SVHEC- Electric Circuits Laboratory Manual.

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	1	-	-	3	3	2
CO2	3	3	2	1	-	-	-	-	-	1	-	-	3	3	2
CO3	3	3	3	2	-	-	-	-	-	1	-	-	3	3	2
CO4	3	3	3	2	-	-	-	-	-	1	-	-	3	3	1
CO5	3	3	3	2	-	-	-	-	-	1	-	-	3	3	1
AVG	3	3	3	2	-	-	-	-	-	1	-	-	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEL21	ENGINEERING PRACTICES LABORATORY (Common to: B.E./B.Tech. all Branches)	L	T	P	C
		0	0	4	2

Course Objectives:

- Acquire skills in operating hand tools and instruments.Provide hands on training on common household plumbing workand wood work
- Provide hands on training on welding processes.
- Provide hands on training on various simple machining processes. Making a tray out of metal sheet using sheet metal work.
- Wiring various electrical joints in common household electrical wire network.
- Soldering and testing simple electronic circuits. Assembling and testing simple electronic components on PCB.

GROUP – A(CIVIL & MECHANICAL)

I) CIVIL ENGINEERING PRACTICES (12)

PLUMBING WORK:

Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components - External thread cutting

WOOD WORK:

Hands-on-exercise:Sawing,PlaningandMaking joints

II) MECHANICAL ENGINEERING PRACTICES (18)

WELDING WORK:

Fabrication of Models with MS Plate using Arc Welding

BASIC MACHINING WORK:

a) Simple Turning
b) Drilling and Tapping Practice

SHEET METAL WORK:

Model making – Trays and funnels

ASSEMBLING AND DISMANTLING WORK:

Assembling a centrifugal pump

GROUP B (ELECTRICAL & ELECTRONICS)

III) ELECTRICAL ENGINEERING PRACTICES (15)

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring 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/quadrac)
g) Study of emergency lamp wiring/Water heater

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IV) ELECTRONIC ENGINEERING PRACTICES **(15)**

SOLDERING WORK:

Soldering simple electronic circuits and checking continuity

ELECTRONIC ASSEMBLY AND TESTING WORK:

Assembling and testing electronic components on a small PCB

ELECTRONIC EQUIPMENT STUDY:

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

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Make a wooden model using carpentry Process.

CO2: Make various shapes using welding processes.

CO3: Make various shapes using manufacturing processes like machining and sheet metal work.

CO4: Wires various electrical joints in common household electrical wire network.

CO5: Solder and test simple electronic circuits. Assemble and test simple electronic components on PCB.

REFERENCE:

1. Manual prepared by the faculty of Civil, Mechanical, Electrical and Electronics and Communication Engineering Department, SVHEC.

E-RESOURCES:

1. https://www.youtube.com/watch?v=GPnQjCrb83Y
2. https://www.youtube.com/watch?v=njwdsMI3PcY

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO2	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO3	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO4	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO5	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
Avg	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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27/04/2024

23ENL21	COMMUNICATION LABORATORY (Common to B.E./B.Tech. all Branches)	L T P C 0 0 4 2

COURSE OBJECTIVES:

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

UNIT-I **MAKING COMPARISONS** **12**

Speaking - Role Play Exercises Based on Workplace Contexts- Talking about Competition- Discussing Progress toward Goals- Talking about Experiences- Talking about Events in Life-Discussing Past Events.
Writing - Writing Emails (Formal & Semi-Formal)

UNIT-II **EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING** **12**

Speaking - Discussing News Stories – Talking about Frequency- Talking about Travel Problems-Discussing Travel Procedures- Talking about Travel Problems- Making Arrangements-Describing Arrangements- Arrangements Discussing Plans and Decisions-Discussing Purposes and Reasons- Understanding Common Technology Terms.
Writing -Writing Different Types of Emails.

UNIT-III **PROBLEM SOLVING** **12**

Speaking - Discussing Predictions- Describing the Climate- Discussing Forecasts and Scenarios- Talking about Purchasing- Discussing Advantages and Disadvantages- Making Comparisons- Discussing Likes and Dislikes- Discussing Feelings about Experiences-Discussing Imaginary Scenarios.
Writing - Short Essays and Reports- Formal/Semi-Formal letters.

UNIT-IV **CLASSIFICATION AND RECOMMENDATIONS** **12**

Speaking - Discussing the Natural Environment- Describing Systems- Describing Position and Movement Explaining Rules (Example- Discussing Rental Arrangements)-Understanding Technical Instructions.

Writing - Writing Instructions -Writing a Short Article.

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UNIT-V **EXPRESSION** **12**

Reading - Describing Things Relatively-Describing Clothing-Discussing Safety Issues (Making Recommendations) Talking about Electrical Devices-Describing Controlling Actions.

Writing - Job Application (Cover Letter + Curriculum Vitae) – Writing Recommendations.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the Course the students will able to

CO1: Speak effectively in group discussions held in a formal/semi formal contexts
CO2: Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
CO3: Create emails, letters and effective job applications with resume.
CO4: Write critical reports to convey data and information with clarity and precision
CO5: Deliver suitable instructions and recommendations for safe execution of tasks

E-RESOURCES:

- https://www.englishclub.com/speaking/
- https://learnenglish.britishcouncil.org/

CO's-PO's MAPPING :

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	2	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	2
CO4	-	-	-	-	-	-	-	-	3	3	-	3
CO5	-	-	1	-	-	-	-	1	3	3	-	2
AVG	-	-	2	-	-	-	-	1	3	3	-	3

1- Low, 2- Medium, 3-High, "-" No Correlation

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BoS / S&H

23MDC21	YOGA FOR HUMAN EXCELLENCE (Common to B.E./B.Tech. all Branches)	L T P C 0 0 1 0

UNIT-I **SIMPLIFIED PHYSICAL EXERCISES** **3**

Physical exercises: Hand exercises – Leg exercises. Breathing exercises: Eye exercises – Kapalabathi. Makarasana. Body massages: Acupressure – Relaxation.

UNIT-II **KAYA KALPA** **3**

Kaya Kalpa Exercise – Aswini Mudra – Moola Bandha – Ojas Breath (Kayakalpa Exercise should be learnt directly from the World Community Service Centre.)

UNIT-III **MEDITATION** **3**

Agna. Santhi : Clearence. Thuriya. Thuriyatheetham meditation

UNIT-IV **HUMAN RESOURCES DEVELOPMENT** **3**

Eradication of worries – Bene its of Blessings – Greatness of Friendship – Neutralization of anger - Individual peace and world peace

UNIT-V **YOGASANAS** **3**

Suriya Namaskar, Padmasana, Vajrasana, Sukasana, Chakrasana (side posture), Viruchasana, Bhujangasana, Yoga mudra, Ustrasana, Maha Mudra, Vakkarasana.

TOTAL : 15 PERIODS

TEXT BOOKS:

1. Yoga Practices – I: VISION, Vethathiri Publications.

2. Yogasana – Vethathiri Publications

REFERENCE BOOKS:

1. Simpli ied Physical Exercises – Vethathiri Publications.

2. Sound health through yoga – Dr. K. Chandrasekaran.

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23EET31	ELECTRICAL MACHINES - I	L	T	P	C
		3	0	0	3

Course Objectives:

- To analyze the magnetic circuits.
- To impart knowledge in construction details, principle operation and performance characteristics of DC machines and transformer.
- To evaluate the different losses and performance of DC machines and transformer using different testing methods.
- To analyze the performance characteristics of DC machines.
- To impart knowledge in three phase transformer connection

UNIT-I **MAGNETIC CIRCUITS** **9**

Definition of MMF, Flux and Reluctance - Leakage Factor - Series and Parallel Magnetic Circuits- Electromagnetic Induction - Fleming's Rule - Lenz's Law - Faraday's laws -statically and dynamically induced EMF- Self and mutual inductance – Analogy of Electric and Magnetic Circuits -Electromechanical -Energy conservation system

UNIT-II **D.C.GENERATORS** **9**

Constructional Details - Principle of Operation - E.M.F Equation - Methods of Excitation - Types – No load and Load characteristics of Series, Shunt and Compound generators - Armature Reaction,– Commutation, losses efficiency-Applications.

UNIT-III **D.C MOTORS** **9**

Principle of Operation - Back E.M.F and Torque Equation - Characteristics of Series, Shunt & Compound Motors -3 point ,4 point Starters Losses and efficiency- Testing of DC Machines - Brake Test, Swinburne's Test & Hopkinson's Test -Applications.

UNIT-IV **SINGLE PHASE TRANSFORMER** **9**

Principle of Operation - Constructional Details - E.M.F. Equation - Transformation Ratio - losses and efficiency, Phasor Diagram – Transformer on No Load - Transformer On Load- Equivalent circuit of OC,SC Test - Regulation - All day Efficiency - Sumpner's Test-Auto Transformer

UNIT-V **THREE PHASE TRANSFORMERS** **9**

Construction of Three Phase Transformer - Transformer Connections – Vector Diagram- Scott connection - Three Phase to Single Phase Transformer conversion – Parallel operation of transformers Toroidal Transformer – Testing of Single phase and 3 phase Transformer - Problem identification in transformer.

TOTAL: 45 PERIODS

Chairman
BoS / EEE

COURSE OUTCOMES

CO's	OUTCOME

The students will be able to:

CO1	Understand the concept of magnetic circuits..
CO2	Explain the principle, types, effect of armature reaction and commutation of DC generator.
CO3	Analyze the performance characteristics of DC motor using various testing methods..
CO4	Understand the principle, equivalent circuit and performance of a single phase transformer.
CO5	Analyze the various transformer connection for specific application.

Text Books:

1. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2. P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.

Reference Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 6th Edition 2017.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2018.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, First Edition 2008.

Online Sources :

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	1	-	-	3	2	1
CO2	3	3	2	2	-	-	-	-	-	1	-	-	3	3	2
CO3	3	3	3	3	-	-	-	-	-	1	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	1	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	1	-	-	3	3	3
Avg	3	3	2	2	-	-	-	-	-	1	-	-	3	3	2

Chairman
BoS / EEE

23EET32	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	1	0	4

Course Objectives:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of Electrostatic fields, electric potential, energy density and their applications.
- Acquire knowledge on the concepts of Magneto static fields, magnetic flux density, vector potential and its applications.
- To impart knowledge on the concepts of Different methods of EMF generation and Maxwell's equations
- Acquire knowledge on the concepts of Electromagnetic waves and characterizing parameters

UNIT-I ELECTROSTATICS – I 10

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

UNIT-II ELECTROSTATICS – II 13

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT-III MAGNETOSTATICS 13

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, Applications.

UNIT-IV ELECTRODYNAMIC FIELDS 11

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

UNIT-V ELECTROMAGNETIC WAVES 13

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.

TOTAL: 60 PERIODS

Chairman
BoS / EEE

COURSE OUTCOMES

CO's	OUTCOME
The students will be able to:	
CO1	Visualize and explain Gradient, Divergence, and Curl operations on electromagnetic vector fields and identify the electromagnetic sources.
CO2	Compute the electrostatic fields, electric potential, energy density along with their applications.
CO3	Analyse the magneto static fields, magnetic flux density, vector potential along with their applications.
CO4	Understand the different methods of emf generation and Maxwell's equations
CO5	Explain the concept of electromagnetic waves and characterizing parameters

Text Books:

1. Mathew N. O. Sadiku, S.V. Kulkarni 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

Reference Books:

1. V.V.Sarwate, 'Electromagnetic fields and waves', Second Edition, Newage Publishers, 2018.
2. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2017.
3. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Sixteenth Edition Eighth Reprint :2015

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	3	1	-	-	-	1	3	2	1
CO2	3	2	1	2	-	-	1	1	-	-	-	1	3	2	1
CO3	3	2	1	2	-	-	1	1	-	-	-	1	3	2	1
CO4	3	2	1	2	-	-	1	1	-	-	-	1	3	2	1
CO5	3	2	1	2	-	-	1	1	-	-	-	1	3	2	1
Avg	**3**	**2**	**1**	**2**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**1**	**3**	**2**	**1**

Chairman
BoS / EEE

23EET33	DIGITAL LOGIC CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives:

- To perform the numeric conversions and design of simple logic circuits.
- To understand the concepts of combinational circuits.
- To construct synchronous and asynchronous sequential circuits.
- To familiarize with programmable logic devices and logic families.
- To understand the fundamental concepts of VHDL programming.

UNIT-I NUMBER SYSTEM AND BOOLEAN ALGEBRA 9

Review of number system; Types and conversion of codes-BCD, Gray code, Excess 3 code; Error detection and correction codes; Boolean algebra: De-Morgan's theorem, Simplification of functions using K-maps- Quine McCluskey method.

UNIT-II COMBINATIONAL CIRCUITS 9

Design of functions using logic gates, Design of Adders, Subtractors, Comparators, Code converters, Encoders, Decoders, Multiplexers and Demultiplexers.

UNIT-III SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip flops - SR, JK , D and T, Shift registers , Analysis of synchronous and asynchronous sequential circuits, Design of synchronous sequential circuits-Counters, Moore and Melay model; state diagram; state reduction; state assignment.

UNIT-IV PROGRAMMABLE LOGIC DEVICES AND LOGIC FAMILIES 9

Programmable Logic Devices: Programmable Logic Array, Programmable array logic Logic families: TTL, ECL,IIL, CMOS.

UNIT-V INTRODUCTION TO VHDL 9

Digital design process flow- Entities and Architecture-Concurrent Statements-Sequential statements -Behavioral, Dataflow, and structural modeling -simple VHDL codes.

TOTAL: 45 PERIODS

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BoS / EEE

COURSE OUTCOMES

CO's	OUTCOME

The students will be able to:

CO1	Apply Boolean algebra and number systems to design the digital circuits.
CO2	Design and realize the combinational circuits using logic gates
CO3	Analyze the synchronous and asynchronous sequential circuits and design the synchronous sequential circuits using basic flip flops.
CO4	Examine the operation of various Programmable Logic Devices and logic families.
CO5	Develop simple programs in VHDL.

Text Books:

1. Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11th Edition, 2018.
2. A.Anand kumar, Fundamentals of digital circuits, 3rd Edition, PHI Learning Pvt Ltd, 2014 .
3. John M.Yarbrough, Digital Logic, Application & Design, Thomson, 2010.

Reference Books:

1. Floyd, Digital Fundamentals, Pearson Education, 10 th edition, 2011.
2. M. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India, 4th edition, 2013.
3. Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 12th Edition, 2017.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	1	-	-	3	-	-
CO2	3	2	3	1	-	-	-	-	-	1	-	-	3	1	-
CO3	3	2	3	1	-	-	-	-	-	1	-	-	3	1	-
CO4	3	2	3	1	-	-	-	-	-	1	-	-	3	1	-
CO5	3	2	-	-	-	-	-	-	-	1	-	-	3	1	-
Avg	3	2	2	1	-	-	-	-	-	1	-	-	3	1	-

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BoS / EEE

23EET34	ELECTRON DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the structure of basic electronic devices.
- To be exposed to active and passive circuit elements.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To learn the required functionality of positive and negative feedback systems.

UNIT-I PN JUNCTION DEVICES 9

PN junction diode –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 characteristics- Zener diode Reverse characteristics – Zener diode as regulator.

UNIT-II TRANSISTORS AND THYRISTORS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.

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.

UNIT-IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT-V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL: 45 PERIODS

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BoS / EEE

COURSE OUTCOMES

CO's	OUTCOME
The students will be able to:	
CO1	Explain the structure and operation of PN junction devices (diode, Zener diode, LED and Laser diode
CO2	Design clipper, clamper, half wave and full wave rectifier, regulator circuits using PN junction diodes
CO3	Analyze the structure and characteristics BJT, FET, MOSFET, UJT, Thyristor and IGBT
CO4	Analyze the performance of various configurations of BJT and MOSFET based amplifier
CO5	Explain the characteristics of MOS based cascade and differential amplifier

Text Books:

1. David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits", 7th Edition, Oxford University Press, 2017.

Reference Books:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3		-	-	-	2	-	-	-	-	-	-	3	2	-
CO3	3	1	-	-	-	-	-	-	2	-	-	-	3	2	-
CO4	3		-	-	-	-	-	-	2	-	-	-	3	2	-
CO5	3	1	-	-	-	-	-	-	2	-	-	-	3	2	-
Avg	1	3	-	-	-	1	-	-	2	-	-	-	3	2	-

Chairman
BoS / EEE

23CST34	C PROGRAMMING AND DATA STRUCTURES	L	T	P	C
	(for B.E.- ECE, EEE)	3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of C programming language
- To learn the concepts of Advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non- liner data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT-I C PROGRAMMING FUNDAMENTALS (8+1 SKILL) 9

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.

UNIT-II C PROGRAMMING - ADVANCED FEATURES (8+1 SKILL) 9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Preprocessor Directives.

UNIT-III LINEAR DATA STRUCTURES (8+1 SKILL) 9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly-Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

UNIT-IV NON-LINEAR DATA STRUCTURES (8+1 SKILL) 9

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

UNIT-V SORTING AND SEARCHING TECHNIQUES (8+1 SKILL) 9

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

TOTAL : 45 PERIODS

Chairman
BoS/CSE& IT

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Develop C programs for any real world/technical application.

CO2 : Apply advanced features of C in solving problems.

CO3 : Write functions to implement linear and non–linear data structure operations.

CO4 : Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.

CO5 : Appropriately use sort and search algorithms for a given application.

CO6 : Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.

2. ReemaThareja, "Programming in C", Second Edition, Oxford University Press, 2016.

REFERENCE BOOKS:

1. Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.

2. Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.

3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education,1983.

4. Ellis Horowitz, SartajSahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia, 2008.

E-RESOURCES:

1. https://www.coursera.org/specializations/data-structures-algorithms
2. https://nptel.ac.in/courses/112107243
3. https://nptel.ac.in/courses/112105598

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	2	1	-	-	1	2	1	3	2	1	3
CO2	1	2	1	2	2	-	-	-	1	1	1	2	2	2	2
CO3	2	3	1	2	3	-	-	-	1	1	1	2	2	1	2
CO4	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
CO5	1	2	1	2	2	1	-	-	1	2	1	3	2	2	3
AVG	**2**	**2**	**1**	**2**	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**2**	**2**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS/CSE&IT

23MAT33	PROBABILITY AND COMPLEX FUNCTIONS (for B.E. ECE & EEE)	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of probability and one dimensional random variable
- To develop an understanding of distribution functions and two dimensional random variables
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering
- To develop an understanding of the standard techniques of complex variable theory inparticular analytic function and its mapping property
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.

UNIT-I **PROBABILITY AND ONE DIMENSIONAL RANDOM VARIABLES** **9+3**

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables- Moments – Moment generating functions

UNIT-II **DISTRIBUTION FUNCTIONS AND TWO-DIMENSIONAL RANDOM VARIABLES** **9+3**

Discrete distributions – Binomial and Poisson distributions, Continuous distributions - Uniform, Exponential and Normal distributions - Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression

UNIT-III **RANDOM PROCESSES** **9+3**

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

UNIT-IV **ANALYTIC FUNCTIONS** **9+3**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, cz, \frac{1}{z}, z^2$-Bilinear transformation

UNIT-V **COMPLEX INTEGRATION** **9+3**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series– Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of realintegrals – Applications of circular contour and semicircular contour (with poles NOT on real axis)

TOTAL : 60 PERIODS

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BoS / S&H

COURSE OUTCOME:

At the end of the Course the students will able to

CO1:	Understand the fundamental knowledge of the concepts of probability and one dimensional random variable which can describe real life phenomenon
CO2:	Understand the basic concepts of two dimensional random variables and apply in engineering problems and knowledge of standard distributions
CO3:	Apply the concept of random processes in engineering disciplines
CO4:	To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property
CO5:	To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals

TEXT BOOKS:

1. Johnson. R.A., Miller. I and Freund. J., "Miller and Freund's Probability and Statistics forEngineers", Pearson Education, Asia, 9th Edition, 2016.
2. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.
3. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition,2018.

REFERENCE BOOKS:

1. Devore. J.L.,"Probability and Statistics for Engineering and the Sciences",Cengage Learning,New Delhi, 8th Edition, 2014.
2. Papoulis. A. and Unnikrishnapillai . S., "Probability, Random Variables and StochasticProcesses", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross . S.M., "Introduction to Probability and Statistics for Engineers and Scientists",5th Edition, Elsevier, 2014.
4. Spiegel. M.R., Schiller. J. and Srinivasan . R.A., "Schaum's Outline of Theory and Problems ofProbability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
5. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons,10th Edition, New Delhi, 2016.

CO'S – PO'S MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	2	-	-	1
CO2	3	3	3	-	-	-	-	-	2	-	-	1
CO3	3	3	2	-	-	-	-	-	2	-	-	1
CO4	3	3	2	-	-	-	-	-	2	-	-	1
CO5	3	3	3	-	-	-	-	-	2	-	-	1
AVG	3	3	3	-	-	-	-	-	2	-	-	1

1- Low, 2- Medium, 3-High, "-" No Correlation

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BoS / S&H

23EST31	ENTREPRENEURSHIP AND STARTUP (Common to: B.E / B.Tech. all Branches)	L	T	P	C
		1	0	0	1

Course Objectives:

The main learning objective of this course is to prepare the students :

- To develop a knowledge on basic concepts of entrepreneurship.
- To know about business opportunities and project evaluation criteria.
- To explore the concept of startups, government schemes and other financial institutions support

UNIT-I ENTREPRENEURSHIP CONCEPTS 5

Entrepreneurship-Meaning-Origin-Functions-Factors Affecting Entrepreneurial Growth- - Role of Entrepreneurship in Economic Development- Skills required for an Entrepreneur - Barriers to Entrepreneurship - Stages in Entrepreneurial Process.

UNIT-II PROJECT FORMULATION AND IDENTIFICATION 5

Identification of business opportunities -Project formulation- Project Classification and Identification - Project Objectives - Technical Analysis, Financial Analysis – Environmental Appraisal of Project - EDP Phases - Project Report Preparation.

UNIT-III START UP OPPORTUNITIES AND FINANCE 5

The New Industrial Revolution- Business Start-up - Rise of the startup Economy- Government Initiatives - Government schemes and incentives - Institutional service to entrepreneur - Sources of Finance.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Enhanced the knowledge of entrepreneurship qualities and skills to startup a business.

CO2: Understand the project classification and prepare a feasibility report.

CO3: Provide vision for the own Start-up and its importance for economic development.

TEXT BOOKS:

1. Gupta C.B and Srinivasan N.P- Entrepreneurial development-Sultan Chand and Sons-Latest edtion.
2. Khanka S.S.-Entrepreneurial Development-S.Chand& Co, RamNagar, New Delhi, Latest edtion.

REFERENCE BOOKS:

1. Vasant Desai-Project Management and Entrepreneurship-Himalaya Publishing House,2023
2. P.Narayana Reddy – Entrepreneurship Text and Cases- cengage learning.2022
3. Prasanna Chandra- Projects planning, analysis, selection, implementation and review Tata McGraw-Hill Publishing Co, Latest edtion.
4. Donald F.Kuratko- Entrepreneurship theory, process & practice-9th Edition-Cengage Learning,2022.

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E-RESOURCES:

1. http://nptel.ac.in/courses/122106032/Pdf/7_2.pdf,"Business Plan",Dr.T. J.Kamalanabhan, Indian Institute of Technology Madras.
2. http://www.nptel.ac.in/syllabus/110104049/,"Entrepreneurial Finance", Dr. B.V. Phani, IIT Kanpur.
3. http:// nptel.ac.in/noc20_mg35/ Entrepreneurship and Start up

CO, PO & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	1	-	-	-	-	-	-	-	3	2	2
CO2	2	3	1	3	-	-	-	-	-	-	-	-	2	1	2
CO3	1	-	3	2	2	-	-	-	-	-	-	-	1	3	2
Avg	**2**	**2**	**2**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

1-low, 2-medium, 3- high, '-'-no correction

Chairman
BoS / MBA

		L	T	P	C
23EEL31	**ELECTRICAL MACHINES LABORATORY – I**	0	0	3	1.5

Course Objectives:

- To impart knowledge to conduct test on various types of machines and transformer.
- To practice different types of wiring and apparatus connection.
- To analyze the operation of various DC machines with different load condition.
- To obtain the characteristics of DC machines and transformer by performing suitable test.

List of Experiments **45**

1. OCC and load characteristics of self excited DC shunt generator.
2. OCC and load characteristics of separately excited DC shunt generator.
3. Load characteristics of DC series generator.
4. Load characteristics of DC shunt motor.
5. Load characteristics of DC series motor.
6. Load characteristics of DC compound motor (Differential and Cumulative).
7. Speed control of DC shunt motor.
8. Swinburne's test on DC shunt motor.
9. OC and SC test on Single Phase Transformer.
10. Load test on Single Phase Transformer.
11. Parallel Operation of Single Phase Transformer.
12. Sumpner's Test on Single Phase Transformer

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO's	**OUTCOMES**
The students will be able to	
CO1	Analyze the performance characteristics of various DC generators..
CO2	Understand the performance characteristics of various DC motors.
CO3	Predetermine the losses and control the speed of a DC motor.
CO4	Predetermine the losses and efficiency of Single Phase Transformer.
CO5	Determine the efficiency of Single Phase Transformer.

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BoS / EEE

Reference Books:

1. SVHEC- Electrical Machines Laboratory – I Manual.

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	2	-	-	3	3	-
CO2	3	3	3	2	2	-	-	-	-	2	-	-	3	3	-
CO3	3	3	2	1	1	-	-	-	-	2	-	-	3	1	-
CO4	3	3	3	3	2	-	-	-	-	2	-	-	3	1	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-	3	1	-
Avg	3	3	2	2	1	-	-	1	-	1	-	-	3	2	-

Chairman
BoS / EEE

		L	T	P	C
23EEL32	**ELECTRON DEVICES AND CIRCUITS LABORATORY**	0	0	3	1.5

Course Objectives:

- To enable the students to understand the behavior of semiconductor device based on experimentation.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and characteristics of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

List of Experiments **45**

1. Characteristics of Semiconductor diode, Zener diode , photo diode , and photo transistor
2. Characteristics of NPN Transistor under common emitter , common collector and common base configurations
3. Characteristics of JFET and draw the equivalent circuit
4. Characteristics of UJT and generation of saw tooth waveforms
5. Design and frequency response characteristics of a Common Emitter amplifier
6. Characteristics of light activated relay circuit
7. Design and testing of RC phase shift and LC oscillators
8. Characteristics of Single Phase half-wave and full wave rectifiers with inductive and capacitive filters
9. Design of Differential amplifiers using FET
10. Measurement of frequency and phase angle using CRO.
11. Realization of passive filters

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO's	**OUTCOMES**
The students will be able to	
CO1	Analyze the characteristics of PN, Zener diode and BJT in CE,CC,CB configurations experimentally
CO2	Analyze the characteristics of JFET and UJT experimentally
CO3	Analyze frequency response characteristics of a Common Emitter amplifier experimentally.
CO4	Analyze the characteristics of RC phase shift and LC oscillators experimentally.
CO5	Analyze the characteristics of half-wave and full-wave rectifier with and without filters experimentally.

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Reference Books:

1. SVHEC- Electron Devices and Circuits laboratory Manual.

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	3	3	-	-	1.5	-	-	3	-	-	3	3
CO2	-	-	3	3	3	-	-	1.5	-	-	3	-	-	3	3
CO3	-	3	2	3	-	-	-	1.5	-	-	3	-	-	3	3
CO4	-	3	3	3	-	-	-	1.5	-	-	3	-	-	3	3
CO5	-	-	-	-	3	-	-	1.5	-	-	3	-	-	3	3
Avg	-	3	2.7	3	3	-	-	1.5	-	-	3	-	-	3	3

Chairman
BoS / EEE

23CSL34	C PROGRAMMING AND DATA STRUCTURES LABORATORY (for B.E. – ECE, EEE)	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To develop applications in C.
- To implement linear and non-linear data structures.
- To understand the different operations of search trees.
- To get familiarized to sorting and searching algorithms.

LIST OF EXPERIMENTS

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Practice of C programming using statements, expressions, decision making and iterative statements
2. Practice of C programming using Functions and Arrays
3. Implement C programs using Pointers and Structures
4. Implement C programs using Files
5. Development of real time C applications
6. Array implementation of List ADT
7. Array implementation of Stack and Queue ADTs
8. Linked list implementation of List, Stack and Queue ADTs
9. Applications of List, Stack and Queue ADTs
10. 10.Implementation of Binary Trees and operations of Binary Trees
11. Implementation of Binary Search Trees
12. Implementation of searching techniques
13. Implementation of Sorting algorithms : Insertion Sort, Quick Sort, Merge Sort
14. Implementation of Hashing – any two collision techniques

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Use different constructs of C and develop applications

CO2 : Write functions to implement linear and non-linear data structure operations

CO3 : Suggest and use the appropriate linear / non-linear data structure operations for a given problem

CO4 : Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval

CO5 : Implement Sorting and searching algorithms for a given application

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CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	2	1	1	-	1	2	1	3	2	1	3
CO2	1	2	1	2	2	-	-	-	1	1	1	2	2	2	2
CO3	2	3	1	2	3	-	-	-	1	1	1	2	2	1	2
CO4	2	1	-	1	1	-	-	-	2	1	1	2	2	3	1
CO5	1	2	1	2	2	1	1	-	1	2	1	3	2	2	3
AVG	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**2**	**2**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS/CSE&IT

23EET41	ELECTRICAL MACHINES - II	L	T	P	C
		3	0	0	3

Course Objectives:

- To analyze the Construction and performance of salient and non – salient type synchronous generators and motors.
- To impart knowledge on principle of operation and performance of synchronous motor.
- To Learn the Construction, principle of operation and performance of Three Phase induction machines.
- To analyze the Starting and speed control of three-phase induction motors.
- To Learn the Construction, principle of operation and performance of single-phase induction motors and special machines.

UNIT-I ALTERNATOR 9

Constructional Details – Types of Rotors – EMF Equation – Synchronous Reactance – Armature Reaction –Equivalent Circuit-Voltage Regulation – EMF, MMF and ZPF Methods – Synchronization of three phase alternators- Synchronizing and Parallel Operation – Synchronizing Power - Power Output Equations - Two reaction theory- Change of Excitation and Mechanical Input, losses and efficiency

UNIT-II SYNCHRONOUS MOTOR 9

Principle of Operation – Torque Equation – Starting Methods -Operation on Infinite Bus bars – V and Inverted V Curves – Input and Output Power Equations – Power Angle Relations – Hunting - Applications.

UNIT-III THREE PHASE INDUCTION MOTOR 9

Constructional Details – Types of Rotors – Squirrel Cage and Slip Ring – Principle of Operation- Starting methods-Slip-Torque Characteristics – Losses and Efficiency – Load Test - No Load and Blocked Rotor Tests - Equivalent Circuit- Separation of No Load Losses – Crawling and Cogging – Double Cage Rotors – Induction Generator. Problem identification in Special electrical machines.

UNIT-IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9

Need for Starters – Types of Starters – DOL/Stator Resistance, Rotor Resistance, Autotransformer, Star-Delta Starters and DOL Starters - Speed Control by Varying Voltage, Frequency, Poles and Rotor Resistance – Braking

UNIT-V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Constructional Details – Double Revolving Field Theory – Starting – Types of single phase induction motors- Equivalent Circuit - Applications

Special Machines: Servo Motor, Stepper Motor and Universal Motor and Switched Reluctance Motor and Linear Induction Motor.

TOTAL: 45 PERIODS

Chairman
BoS / EEE

COURSE OUTCOMES

CO's	OUTCOME

The students will be able to:

CO1	Acquire knowledge about the constructional details and principle of operation of alternators.
CO2	Analyze the performance characteristics of synchronous motor
CO3	Understand the Construction, principle of operation and performance of induction machines.
CO4	To know about Starting and speed control of three Phase induction motors
CO5	To gain the knowledge on Construction, principle of operation and performance of single phase induction motors and special machines.

Text Books:

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 5th Edition 2017.
2. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, edition 2, 2021.
3. GuptaJ.B.,—ElectricalMachines(AC&DCMachines)‖,4thEdition,SKKataria&Sons,New Delhi,2012.
4. R.K.Rajput, "Electrical Machine", Laxmi Publications, 5th Edition 2008.

Reference Books:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Education 2017.
2. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition, Reprint 2015.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO2	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO3	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO4	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO5	3	3	1	1	2	-	-	1	-	-	-	-	3	3	2
Avg	3	3	1.6	2.3	2.6	-	-	1	-	-	-	-	3	3	2

Chairman
BoS / EEE

23EET42	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives:

- To familiarize the students with the application of Special IC's.
- To understand the operation of A/D and D/A converters using Op-amp.
- To understand the Non-linear applications of Op-amp.
- To understand the linear applications of Op-amp.
- To understand the fundamentals and characteristics of Op-amp.

UNIT-I CHARACTERISTICS OF OPERATIONAL AMPLIFIER 9

Basic Parameters of Operational Amplifier - Block diagram of Operational Amplifier - Characteristics of Ideal and Practical Operational Amplifier, transfer characteristics - Inverting and Non-inverting Amplifiers, Voltage follower -DC characteristics-AC characteristics-Frequency Response, Stability - Frequency Compensation techniques.

UNIT-II LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIER 9

Summing amplifier- Differential amplifier - Instrumentation amplifier - Integrator and Differentiator - Voltage to Current and Current to Voltage converters, Oscillators-Sine Wave (RC Phase Shift and Wein Bridge), Triangular Wave and Saw tooth Wave Generation.

UNIT-III NON-LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Comparators-Zero crossing detector, Schmitt Trigger, Window detector -Clippers, Clampers, Peak Detector-Sample and Hold circuit- Astable and Monostbale Multivibrators - Active filters-Analysis and Design of first order low pass, high pass, band pass and Band stop Butterworth filters.

UNIT-IV A-D AND D-A CONVERTERS 9

DAC/ADC performance characteristics -Digital to Analog Converters: Binary weighted and R-2R Ladder types - Analog to digital converters: Successive approximation and Flash Type. Single Power Supply Operational Amplifiers: Need for single power supply operational amplifiers, AC Inverting and Non-Inverting amplifiers

UNIT-V SPECIAL ICS 9

555 Timer circuit -Functional block, Astable and Monostable characteristics, applications; Voltage regulators - fixed voltage regulators, adjustable voltage regulators -switching regulators.

TOTAL: 45 PERIODS

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BoS / EEE

COURSE OUTCOMES

CO's	OUTCOME

The students will be able to:

CO1	Analyze the DC and AC characteristics of the Op-amp.
CO2	Develop simple Op-amp based circuits for linear applications.
CO3	Design and analyze the Op-Amp for non linear applications.
CO4	Construct A/D and D/A converters for signal processing applications and analyse the effect of single power supply Op-Amp.
CO5	Design and Analyze various application circuits using Special IC's

Text Books:

1. David A.Bell, 'Op-amp & Linear ICs', Oxford, 2013.
2. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2015.
3. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', Tata McGraw Hill, 2009

Reference Books:

1. Michael Jacob J, 'Applications and Design with Analog Integrated Circuits', Prentice Hall of India, New Delhi, 2010.
2. Robert F.Coughlin, Fredrick F. Driscoll, Op-amp and Linear ICs, Pearson, 6th edition,2012.
3. S. Salivahanan and V.S. Kanchana Bhaaskaran , Linear Integrated Circuits, First reprint, Tata McGraw Hill, 2015.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	-	3	2	2
CO5	2	3	3	-	-	-	-	-	-	-	-	-	3	2	3
Avg	3	2	3	-	-	-	-	-	-	-	-	-	3	2	2

Chairman
BoS / EEE

23EET43	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

Course Objectives:

- To get acquaintance with the architecture of 8085 processor.
- To apply the concepts of interfacing peripherals with 8085.
- To understand the architecture and addressing modes of 8051 controller.
- To introduce commonly used peripheral/interfacing ICs.
- To study the architecture and programming of PIC Microcontroller.

UNIT-I 8085 MICROPROCESSOR 9

Introduction to 8085 Microprocessor – Architecture – Pin configuration –Instruction Set – Addressing Modes – Interrupts – Timing Diagrams – Memory Interfacing – Simple Assembly Language Programs.

UNIT-II INTERFACING IC's 9

Study of Architecture and programming of ICs: 8255 PPI, 8259PIC, 8251USART, 8279 Keyboard display controller and 8254 Timer/Counter – Interfacing with 8085 -A/D and D/A converter interfacing.

UNIT-III 8051 MICROCONTROLLER 9

Introduction to 8051 Microcontroller – Architecture – Memory Organization–Special Function Registers – Program Counter – PSW register – Stack – Instruction set – Addressing modes.

UNIT-IV INTERFACING I/O PERIPHERALS WITH 8051 9

Timers and Counters – Serial Communication – Interrupts – Interfacing with Seven segments LED display, LCD display , A/D and D/A converters and Stepper motor.

UNIT-V PIC MICROCONTROLLER 9

PIC microcontrollers: History and features –Architecture – memory organization – addressing modes – instruction set – PIC Programming –I/O port, Data Conversion, RAM & ROM Allocation.

TOTAL: 45 PERIODS

Chairman
BoS / EEE

COURSE OUTCOMES

CO's	OUTCOME

The students will be able to:

CO1	Explain the basic concepts of 8085 microprocessor.
CO2	Understand the different interface with 8085.
CO3	Summarize the basic concepts of 8051 microcontroller.
CO4	Interface peripheral devices with 8051 microcontroller.
CO5	Analyze about PIC microcontroller and programming.

Text Books:

1. R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085/8080A", Penram International Publishing, Sixth Edition 2013.
2. Soumitra Kumar Mandal, "Microprocessors and Microcontrollers Architecture, Programming and System Design 8085,8086 and 8051", 8th Edition, Tata McGraw Hill Education (India) Pvt. Ltd, New Delhi, 2013 .
3. Muhammad Ali Mazidi, Danny E. Causey & Rolin D. McKinlay, "The PIC Microcontroller and Embedded Systems Using Assembly and C for PIC 18", 2nd Edition, Pearson Education, New Delhi, 2021.

Reference Books:

1. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, programming and system design 8085, 8086, 8051, 8096", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.
2. Subrata Ghoshal, "8051 Microcontrollers, 2/e: Internals, Instructions, Programming &Interfacing", 2nd Edition, Pearson Education, 2014.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	1	3	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	1	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	3	-
Avg	3	2	1	1	1	-	-	-	-	-	-	-	2	3	-

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BoS / EEE

23EET44	TRANSMISSION AND DISTRIBUTION	L	T	P	C
		3	0	0	3

Course Objectives:

- To Understand the generation and various power plants
- To understand the various types of transmission system and develop the mathematical models for line parameters.
- To compute the voltage regulation and efficiency using line parameters.
- To analyze the voltage distribution in insulator strings and grading of cables in transmission lines.
- To understand the different types of distribution system and substations with its layout

UNIT-I GENERATION OF ELECTRIC POWER 9

Structure of electric power system; Sources of Electric Energy; Load Characteristics and Economic Aspects; Power Plants: Steam, Hydroelectric, Nuclear, Gas, Wind and Solar.

UNIT-II LINE PARAMETERS 9

Resistance, Inductance and capacitance of single phase and three phase line - Stranded and bundled conductor configurations - Symmetrical and unsymmetrical spacing - Transposition of line conductors - Double circuit lines - Skin and proximity effects.

UNIT-III PERFORMANCE OF TRANSMISSION LINES 9

Regulations and Efficiency of Short Lines, Medium transmission lines by nominal T & π methods - Long Transmission line by Rigorous Solutions - ABCD parameters - Ferranti Effect - Corona Effect - Corona loss, Sag calculation.

UNIT-IV INSULATORS AND CABLES 9

Insulators - Types and comparison - Voltage distribution in insulator string - String efficiency - Methods of improving string efficiency- Cables - Types - Capacitance - Grading of cables - Testing of cables.

UNIT-V DISTRIBUTION SYSTEM 9

Substation equipment and layouts, Methods of grounding - AC distribution - single phase and three phase, 4-wire distribution- System comparison- Primary and Secondary distribution networks - Underground Distribution system - Laying, Terminal equipment.

TOTAL: 45 PERIODS

Chairman
BoS / EEE

COURSE OUTCOMES

CO's	OUTCOME

The students will be able to:

CO1	Know the concepts of Generation of Electrical Energy and power plants
CO2	Analyze the line parameters of overhead transmission lines
CO3	Determine the voltage regulation and transmission efficiency of short, medium and long transmission lines.
CO4	Classify the different types of cables and insulators and estimate the string efficiency of insulators.
CO5	Analyze the performance of single and three phase distribution system

Text Books:

1. C.L .Wadhwa, Electrical Power Systems, New Age International Edition, New Delhi 2018 .
2. I.J.Nagrath, D.P.Kothari, Power System Engineering, Tata McGraw Hill Ltd, New Delhi, 2017.
3. V. Kamaraju , Electrical Power Distribution Systems, Tata McGraw Hill Ltd, New Delhi, 2017.

Reference Books:

1. Turan Gonen, Electric Power Distribution system, Engineering, CRC Press 2017
2. H Partap Art and Science of Utilization of Electrical Energy, Dhanpat Rai & Sons 2017.
3. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	1	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	1	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	1	-	-	1	-	-
CO4	3	-	-	-	-	-	-	-	-	1	-	-	-	1	-
CO5	3	-	-	-	-	-	-	-	-	1	-	-	-	1	-
Avg	3	1	-	-	-	-	-	-	-	1	-	-	1	1	-

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BoS / EEE

23EET45	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

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

UNIT-I MEASUREMENT OF VOLTAGE AND CURRENT 9

Introduction to essential requirements of instruments- Three operating forces of analog instruments - Permanent Magnet Moving Coil (PMMC): Construction of PMMC Instruments - Ammeter Shunts- Voltmeter Multipliers. Moving Iron Instruments: Classification – Construction - Comparison between Attraction and Repulsion types of Instruments.

UNIT-II MEASUREMENT OF POWER AND ENERGY 9

Introduction to Electrodynamometer type instruments- Electrodynamometer Wattmeter: Construction – Theory- Torque Equation Errors. Single Phase Induction Type Meters: Construction –Theory and Operation of Single Phase Induction Type Energy Meters .Testing of Energy Meters: Phantom loading.

UNIT-III POTENTIOMETERS AND INSTRUMENT TRANSFORMERS 9

D.C. Potentiometers: Introduction - Basic Potentiometer Circuit – Standardization - Laboratory type (Crompton's) potentiometer – Applications. Instrument Transformers: use of Instrument transformers- Ratios-Burden. Design Features of C.T Current Transformers (C.T) – Potential Transformers (P.T). Difference between C.T and P.T. Measurement of Power using Instrument Transformers.

UNIT-IV MEASUREMENT OF RESISTANCE AND IMPEDANCE WITH BRIDGES 9

Classification of Resistances- Measurement of Medium Resistance - Wheat Stone Bridge - Limitations of Wheat Stone Bridge. Low Resistance- Kelvin Double Bridge. High Resistance – Meggar (Earth tester). A.C. Bridges: Introduction - Sources and Detectors - Measurement of Self Inductance & Capacitance: Maxwell's Inductance Bridge - Capacitance Bridge - Anderson's Bridge - Schering Bridge - Wien's Bridge- Sources of Errors in Bridge Circuits.

UNIT-V DIGITAL INSTRUMENTATION (BLOCK DIAGRAM APPROACH) 9

Multi function metering, Cathode Ray Oscilloscope. Impedance Measurement: Q meter. RMS Measurement: True RMS Meters. Digital meters: Time, Period and Frequency measurements. Digital Voltmeters: Ramp type Voltmeters. Shielding and Grounding.

TOTAL: 45 PERIODS

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BoS / EEE

COURSE OUTCOMES

CO's	OUTCOME
The students will be able to:	
CO1	Understand the working principle of meters for measurement of Voltage and Current.
CO2	To Know the working principle of meters for measurement of Power and Energy.
CO3	Apply potentiometers and instrument transformers for measurement of electrical parameters.
CO4	Measure the unknown impedance using AC bridges.
CO5	Explore the recent developments in Digital Measurements and Instruments.

Text Books:

1. Sawhney A.K. "A Course in Electronic Measurements and Instrumentation",2nd Edition, DhanpatRai & Co. Pvt. Ltd, New Delhi ,2015.
2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.
3. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009.

Reference Books:

1. Robert B. Northrop, "Introduction to Instrumentation and Measurements", 3rd Edition, CRC Press, 2017.
2. Kalsi, H.S., "Electronic Instrumentation", 3rdedition, Tata McGraw Hill Publishing Company, New Delhi, 2012.
3. R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	2	1	1	1	-	-	-	-	-	-	-	3	3	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	3	3	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	3	3	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-	2	2	-
Avg	3	2	1	1	1	-	-	-	-	-	-	-	3	3	-

Chairman
BoS / EEE

23CYT41	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY (Common to: B.E./B.Tech. all Branches)	L 2	T 0	P 0	C 2

Course Objectives:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and sustainable practices
- To imbibe awareness on manmade activities and population issues

UNIT-I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity – values of biodiversity, India as a mega-diversity nation – threats to biodiversity – conservation of biodiversity. Activity: Documentation of ecosystems/Biodiversity within Campus.

UNIT-II ENVIRONMENTAL POLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts. Activity: Documentation of pollution issues in Erode district.

UNIT-III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation - New Energy Sources: Need and different types of new energy sources. Concept, origin and applications of - Hydrogen energy, Ocean energy, Tidal energy and geothermal energy conversion. Activity: Documentation of available renewable resources in Erode district.

UNIT-IV SUSTAINABILITY AND MANAGEMENT 6

Development, GDP, Sustainability- concept, needs and challenges - Sustainable Development Goals - Concept of Carbon Credit, Carbon Footprint. Circular economy, ISO 14000 Series, Material Life Cycle Assessment, Environmental Impact Assessment. Green Engineering. Activity: Documentation of sustainable goals of Tamilnadu.

UNIT-V HUMAN POPULATION AND DISASTER MANAGEMENT 6

Population growth, Population explosion— Family Welfare Program – Environment and human health. Human rights – HIV/AIDS – Women and Child Welfare – Role of Information Technology in environment and human health – Disaster management: Floods, earthquake, cyclone and landslides. Activity: Documentation of women development schemes in Tamilnadu.

TOTAL :30 PERIODS

Chairman
BoS / S&H

COURSE OUTCOMES:

At the end of the course the students will be able to	
CO1:	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
CO2:	To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
CO3:	To identify and apply the understanding of renewable and non-renewable resources
CO4:	To recognize the different goals of sustainable development and sustainability practices and apply them for future development.
CO5:	To aware the population issues and to handle the disaster issues

TEXT BOOKS:

1. Dr. A.Ravikrishnan "Environmental Sciences and Sustainability", 2nd Edition, Sri Krishna Hitech Publishing Company Pvt. Ltd, 2022.

2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2010.

3. Gilbert M.Masters& Wendell P Ela, 'Introduction to Environmental Engineering and Science', 3rdedition, Prentice – Hall of India Pvt. Ltd, New Delhi, 2008.

REFERENCE BOOKS:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2009.

2. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2022.

3. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2023.

E- SOURCES:

Unit 1:https://www.youtube.com/watch?v=Ar04qG1P8Es (IIT ROORKEE NPTEL)&https://www.youtube.com/watch?v=SHxAOoxhKTA (IIT KANPUR NPTEL)
Unit 2:https://www.youtube.com/watch?v=I7Z34WU257U (IIT ROORKEE NPTEL)
Unit 3:https://www.youtube.com/watch?v=1kUE0BZtTRc (NATIONAL GEOGRAPHIC)
Unit 4:https://www.youtube.com/watch?v=Crd3CFq5B4s (IITM NPTEL)
Unit 5:https://www.youtube.com/watch?v=sMqtwbKc8EA (FINANCIAL TIMES)

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CO's& PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	2	3	-	-	-	-	2
CO2	3	2	-	-	-	3	3	-	-	-	-	2
CO3	3	-	1	-	-	2	2	-	-	-	-	2
CO4	3	2	1	1	-	2	2	-	-	-	-	2
CO5	3	2	1	-	-	2	2	-	-	-	-	1
AVG	3	2	1	1	-	2	2	-	-	-	-	2

1- low,2-medium,3-high, '-'- nocorrelation

Chairman
BoS / S&H

23EEL41	ELECTRICAL MACHINES LABORATORY – II	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To find the regulations and understand the concept of parallel operation of synchronous generator
- To understand the performance characteristics of various electrical machines.
- To analyze the performance parameters of ac motors by conducting suitable tests.

List of Experiments **45**

1. Voltage regulation of salient pole alternator by direct loading method.
2. Regulation of three-phase alternator by EMF, MMF and ZPF methods.
3. Parallel operation of alternators.
4. Performance curves of three phase squirrel cage induction motor by direct loading method.
5. Performance characteristics of single phase capacitor run induction motor by direct loading method.
6. Separation of no load losses in three phase squirrel cage induction motor.
7. Equivalent circuit and circle diagram of three phase induction motor.
8. Speed control of three phase induction motor.
9. Braking methods of three phase induction motor, Slip Ring Induction Motor
10. No load and Load test on self excited induction generator.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO's	OUTCOMES
The students will be able to	
CO1	Compute the voltage regulation of alternators using different methods.
CO2	Analyze the performance characteristics of alternators with parallel operation.
CO3	Analyze the load characteristics, circle diagram, and braking methods of three phase induction motor.
CO4	Analyze the speed control characteristics of three phase induction motor.
CO5	Demonstrate the load characteristics of self-excited induction generator and single phase induction motor.

Chairman
BoS / EEE

Reference Books:

1. SVHEC- Electrical Machines Laboratory – II Manual.

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	2	1	-	-	-	3	-	-	-	3	1	-
CO2	-	3	-	2	2	-	-	-	3	-	-	-	3	1	-
CO3	2	3	-	1	3	-	-	-	3	-	-	-	3	1	-
CO4	-	3	-	3	3	-	-	-	3	-	-	-	2	1	-
CO5	-	1	-	-	1	-	-	-	3	-	-	-	2	1	-
Avg	1	3	-	2	2	-	-	-	3	-	-	-	3	1	-

Chairman
BoS / EEE

		L	T	P	C
23EEL42	**LINEAR AND DIGITAL CIRCUITS LABORATORY**	**0**	**0**	**3**	**1.5**

Course Objectives:

- To learn design, testing and characterizing of circuit behavior with combinational logic gate ICs.
- To learn design, testing and characterizing of circuit behavior with register/ counter and sequential logic ICs.
- To learn design, testing and characterizing of circuit behavior with OPAMP ICs.
- To learn design, testing and characterizing of circuit behavior with analog ICs like 555 timer, VCO and regulators.
- To learn design, testing and characterizing of circuit behavior with digital ICs like decoders, multiplexers.

List of Experiments **45**

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa.
3. Parity generator and parity checking.
4. Encoders and Decoders.
5. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Multiplexer and de multiplexer.
8. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
9. Voltage to frequency characteristics of NE/ SE 566 IC.
10. Variability Voltage Regulator using IC LM317.
11. Timer IC application: IC 555 & IC565 Astable, Monostable & Bistable

TOTAL: 45 PERIODS

Chairman
BoS / EEE

COURSE OUTCOMES

CO's	OUTCOMES

The students will be able to

CO1	Ability to understand and implement Boolean Functions.
CO2	Ability to understand the importance of code conversion.
CO3	Ability to Design and implement circuits with digital ICs like decoders, multiplexers, register.
CO4	Ability to acquire knowledge on Application of Op-Amp.
CO5	Ability to Design and implement counters using analog ICs like timers, VCOs and digital ICs like Flip-flops and counters.

Reference Books:

1. SVHEC- Linear and Digital Circuits Laboratory Manual.

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	2	1	-	-	-	3	-	-	-	3	1	-
CO2	-	3	-	2	2	-	-	-	3	-	-	-	3	1	-
CO3	2	3	-	1	3	-	-	-	3	-	-	-	3	1	-
CO4	-	3	-	3	3	-	-	-	3	-	-	-	2	1	-
CO5	-	1	-	-	1	-	-	-	3	-	-	-	2	1	-
Avg	1	3	-	2	2	-	-	-	3	-	-	-	3	1	-

Chairman
BoS / EEE

23EEL43	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

- Study the Architecture of 8085 microprocessor & 8051 microcontroller.
- To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
- Learn the design aspects of I/O and Memory Interfacing circuits.

List of Experiments **45**

8085 Microprocessor based Experiments:

1. Simple arithmetic operations: addition / subtraction / multiplication /division.
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers.
   (ii) Programs using Rotate instructions.
3. Interface of A/D converter & D/A converter.
4. Interfacing of traffic light controller.
5. I/O Port / Serial communication.
6. Interfacing of stepper motor control.

8051 Microcontroller based Experiments:

7. Demonstration of basic instructions with 8051 Micro controller execution, including:
   (i) Conditional jumps & looping
   (ii) Calling subroutines.
8. Programming I/O Port and timer of 8051.
   (i) Interface with A/D & D/A
   (ii) Interface with DC & AC motors

PIC Microcontroller based Experiments:

9. Simple arithmetic operations: addition / subtraction / multiplication /division.
10. Programming with control instructions:
    (i) Ascending / Descending order, Maximum / Minimum of numbers.
    (ii) Programs using Rotate instructions.

TOTAL: 45 PERIODS

Chairman
BoS / EEE

COURSE OUTCOMES

CO's	OUTCOMES

The students will be able to

CO1	Write a program to perform different arithmetic and logic operation in 8085.
CO2	Program for code conversions in 8085.
CO3	Acquire knowledge on A/D and D/A. using 8085.
CO4	Understand the interfacing of serial communication with 8051.
CO5	Write a simple programs using PIC Microcontroller.

Reference Books:

1. SVHEC- Microprocessor and Microcontroller laboratory Manual.

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	1	2	-	1	2	3	-	1	1	3	-
CO2	3	3	1	3	1	2	-	1	2	3	-	1	1	3	-
CO3	3	3	2	3	2	2	-	1	2	3	-	1	2	3	-
CO4	3	2	1	3	1	2	-	1	2	3	-	1	1	3	-
CO5	3	3	1	3	2	2	-	1	2	3	-	1	1	3	-
Avg	3	3	1	3	1	2	-	1	2	3	-	1	1	3	-

Chairman
BoS / EEE

23MDC41 **SOFT SKILLS AND ANALYTICAL SKILLS - I**

L	T	P	C
1	0	0	0

COURSE OBJECTIVES:

- ☐ To make the students aware of critical thinking.
- ☐ To understand the significance of emotional intelligence in self-growth.
- ☐ Basic Knowledge about the Arithmetic Ability.
- ☐ To solve the problems in Business Computations.
- ☐ Understand the basics of Data Interpretation

UNIT-I **CRITICAL THINKING** **3**

Active Listening –Observation –Curiosity –Introspection –Analytical Thinking –Open-mindedness – Creative Thinking.

UNIT-II **EMOTIONAL INTELLIGENCE** **3**

Transactional analysis – Empathy – Sympathy - Conflict management.

UNIT-III **ARITHMETIC ABILITY** **3**

Vedic Maths - Algebraic operations BODMAS, Fractions, Divisibility rules, LCM & GCD (HCF).

UNIT-IV **BUSINESS COMPUTATIONS** **3**

Time & Distance, Partnership, simple & compound interest.

UNIT-V **DATA INTERPRETATION** **3**

Line Graphs - Venn diagrams - Mixed Graphs.

TOTAL : 15PERIODS

Chairman
BOS / S&H

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Analyse and evaluate arguments and identify most common fallacies.

CO2 : Discover personal competence and techniques of building emotional intelligence.

CO3 : Enhance the Aptitude Round Clearing ability in interview process.

CO4 : Infer the concepts of Business Computations.

CO5 : Interrupt the data.

TEXT BOOKS:

1. Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.
2. Soft Skills: an Integrated Approach to Maximise Personality, Gajendra S. Chauhan, Sangeeta Sharma, Wiley India.

REFERENCE BOOKS:

1. Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar, New Delhi-110055.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude for Competitive Examination by AbhijitGuha, Tata Mc Graw Hill Publications.
4. Personality Development and Soft Skills, Barun K. Mitra, Oxford Press
5. Communication Skills for Engineers and Scientists , Sharma, Sangeeta & Binod Mishra., PHI India. (2 nd edition).

Chairman
BoS / S&H

23EET51	POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:

- Able to create a model or perform a power system component phase analysis
- Able to draw impedance diagram for a power system network and to understand per unit quantities.
- Able to understand the load flow solution of a power system using different methods.
- Able to find the sequence components of currents for unbalanced power system network.
- Able to analyze the steady state, transient and dynamic stability concepts of a power system.

UNIT-I POWER SYSTEM – AN OVERVIEW AND MODELLING 9

Need for system analysis in planning and operation of power system – modeling of synchronous generator and motor, transformer and transmission line – per unit system–change of base – impedance and reactance diagrams.

UNIT-II POWER FLOW ANALYSIS 9

Primitive network and network matrices – Y-bus formulation by direct inspection and singular transformation methods – problem definition – derivation of power flow equation – power flow solution by Gauss Seidel –Newton Raphson methods.

UNIT-III SYMMETRICAL FAULT ANALYSIS 9

Need for short circuit study – approximations in modeling – fault MVA – symmetrical short circuit analysis – Thevenin's equivalent representation –bus impedance matrix formulation – bus building algorithm – symmetrical fault calculations using bus impedance matrix.

UNIT-IV UNSYMMETRICAL FAULT ANALYSIS 9

Unsymmetrical fault analysis – symmetrical component transformation – sequence impedances – sequence networks – types of unsymmetrical fault – unsymmetrical fault analysis on an unloaded generator – unsymmetrical fault analysis on power system.

UNIT-V STABILITY ANALYSIS 9

Concept of stability in power system – swing equation– equal area criterion – critical clearing angle and time – solution of swing equation by modified Euler's method and Runge-Kutta method.

TOTAL : 45 PERIODS

Chairman
BoS / EEE

COURSE OUTCOMES:

CO's	OUTCOMES
	The students will be able to:
CO1	Model the various power system components and to draw the reactance diagram for practical power system networks. .
CO2	Solve the power flow equation for power system networks using iterative solution techniques
CO3	Carry out symmetrical fault analysis for power system networks using bus impedance matrix formulation.
CO4	Carry out unsymmetrical fault analysis for various power system networks using symmetrical components.
CO5	Model the power system for stability analysis and to solve the swing equation using modified Euler's and Runge-Kutta methods.

TEXT BOOKS:

1. Nagrath.I.J, Kothari.D.P, "Modern Power System Analysis", Tata McGraw Hill,3rd Ed., 2003.
2. HadiSaadat, "Power System Analysis", Tata McGraw Hill Pub Co. Ltd., New Delhi, 2002.

REFERENCES:

1. Gupta, J.B., "A Course in Electrical Power", S.K.Kataria and Sons, 2009.
2. Abhijit Chakrabarti, Sunita Halder, "Power System Analysis: Operation and Control", 2ndEdition, Prentice Hall of India Learning Private Limited, 2008.
3. Stagg.G.W, and El-Abaid.A.H.,"Computer Methods in Power System Analysis", Tata McGraw Hill Pub Co. Ltd, New Delhi, 2008.
4. John J. Grainger & William Stevenson JR., "Power system Analysis by Tata McGraw-Hill New Delhi, 1st Ed., 2003.

Online Sources:

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	1	-	-	-	1	1	-
CO2	3	2	2	2	1	-	-	-	1	-	-	-	1	1	-
CO3	3	2	2	2	1	-	-	-	1	-	-	1	1	1	-
CO4	3	2	2	2	2	-	-	-	1	-	-	1	1	1	-
CO5	3	3	2	2	2	-	-	-	1	-	-	1	1	1	-
Avg	3	2.6	2	1.8	1.4	-	-	-	1	-	-	1	1	1	-

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23EET52	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives:

- To acquire the knowledge of power semiconductor switches and its characteristics
- To understand the concept of control and working of various power converters
- To understand and analyze the various types of choppers.
- To understand buck, boost and buck-boost DC-DC converters for the given specifications.
- To acquire the knowledge in the characteristics of electric motor drives

UNIT-I POWER SEMICONDUCTOR DEVICES 9

Introduction - Power Diodes - Power Transistors - Power MOSFETs – IGBTs - Thyristor family: SCR, TRIAC, GTO, IGCT - Static and Dynamic characteristics –Introduction to intelligent power Module Protection circuits - Series and parallel connections – Interpretation of power device data sheet

UNIT-II AC TO DC CONVERTERS 9

Single phase and three phase half and fully controlled converters – Effect of source inductance – Analysis of converters with R and RL loads - Performance parameters - Dual converters,Single and Three phase inverters with R,RL load.

UNIT-III DC CHOPPERS 10

Classification - Control strategies – Switches Mode Regulators – Non Isolated DC-DC Converters: Buck, Boost, Buck-Boost and Sepic Converters- Isolated DC-DC Converters: Flyback and Forward Converters-Performance analysis – Applications, Concept of resonant converters

UNIT-IV INVERTERS 8

Principle of working: Step-down, step-up, voltage commutated, current commutated chopper, switching regulators: buck, boost & buck-boost, SMPS topologies, Concept of matrix converter, inverter fed dc drives, Electric vehicle

UNIT-V AC CONVERTERS 9

Stator voltage control - V/f control - Rotor resistance control-Static Scherbius drive - Self-control of synchronous motor-V3F drives-Applications

TOTAL : 45 HOURS

COURSE OUTCOMES

CO's	OUTCOMES
The students will be able to:	
CO1	Describe the construction of switching devices and its characteristics
CO2	Analyze the performance of AC-DC converter for different loads.
CO3	Apply the various converter topologies to design and analyze the switched mode regulators.
CO4	Design buck, boost and buck-boost DC-DC converters for the given specifications
CO5	Analyze the operation and performance of AC drives

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CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	3	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	2	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	-	3	-	-	-	2	2	2
CO4	3	3	3	3	-	-	-	-	3	-	-	-	2	2	2
CO5	3	3	3	3	-	-	-	-	2	-	-	-	2	2	2
Avg	3	3	3	3	-	-	-	-	2.6	-	-	-	2.4	2.4	2.4

Text Books:

1. Ned Mohan, Tore M. Underland and William P. Robbins, "Power Electronics: Converters, Applications and Design", Third Edition, John Wiley & Sons, 2007.
2. Muhammed H Rashid, " Power Electronics- circuits, devices and applications" Pearson Education; Fourth edition 2017.

Reference Books:

1. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
2. Joseph Vithayathil "Power Electronics" Tata McGraw Hill, 2010.
3. Erickson, Maksimovic, and Dragan "Fundamentals of Power Electronics", Kluwer academic publishers, 2020.
4.
5. Shaffer, Randall, "Fundamentals of Power Electronics with Matlab", Firewall media, 2013

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

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23EET53	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- Students will be able to identify and explain different representations of systems, including state-space models and transfer function models.
- To make the students to analyze the stability of linear systems in the time domain and frequency domain.
- To make the students to analyze the stability of linear systems in the frequency domain.
- To make the students to design compensator based on the time and frequency domain specifications.
- To develop linear models: mainly state variable model and Transfer function model

UNIT-I MODELING OF LINEAR TIME INVARIANT SYSTEM (LTIV) 9

Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Mechanical, Electrical and Electromechanical systems – Transfer function representations: Block diagram reduction Signal flow graph.

UNIT-II TIME RESPOSE ANALYSIS OF CONTROL SYSTEMS 9

Standard Test Signals -Time Response of First and Second Order System, Time Domain-Specifications - Generalized Error Series - Steady State Error - Static and Dynamic Error Constants-concept of mathematical modeling of PID controllers.

UNIT-III FREQUENCY RESPONSE 9

Bode plots, Polar plots ; Frequency domain specifications: Gain Margin and phase Margin; Nyquist plot: Nyquist stability criterion.

UNIT-IV STABILITY OF CONTROL SYSTEM 9

Characteristics Equation - Location of Roots in S Plane for Stability - Routh Hurwitz Criterion - Root Locus Analysis - Effect of Pole Zero Additions on Root Locus.

UNIT-V DESIGN OF FEED BACK CONTROL SYSTEM 9

Design specifications – Lead, Lag and Lag-lead compensators using Root locus and Bode plot techniques –PID controller - Nichols technique - PID control in State Feedback form.

TOTAL : 45 PERIODS

COURSE OUTCOMES

The students will be able to:

CO1	Represent simple systems in transfer function and state variable forms.
CO2	Analyze simple systems in time domain
CO3	Analyze simple systems in frequency domain.
CO4	Infer the stability of systems in time and frequency domain.
CO5	Interpret characteristics of the system and find out solution for simple control problems.

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TEXT BOOKS:

1. Benjamin C. Kuo, "Automatic Control Systems", 7th edition PHI Learning Private Ltd, 2017.
2. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers 2021.

REFERENCES:

1. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Education Pearson, 3 Impression 2017.
2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2014.
3. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private Ltd, 6th Edition, 2021
4. NPTEL Video Lecture Notes on "Control Engineering" by Prof.S.D.Agashe, IIT Bombay.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	-	3	1	1
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	2	1
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	2	2
CO5	3	3	3	2	3	-	2	-	-	-	-	-	3	2	2
Avg	3	3	3	2.2	3	-	2	-	-	-	-	-	3	1.8	1.4

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23EEL51	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

- Students will be able to analyse the performance of DC- DC
- Students will be able to analyze the performance of Inverters.
- Students will be able to analyse the performance of AC voltage controller
- Students will be able to analyse the performance of Permanent magnet synchronous motor
- Students will be able to analyse the performance of induction motor.

45

List of Experiments

1. V-I characteristics of SCR and TRIAC.
2. V-I characteristics of MOSFET and IGBT.
3. Switching characteristics of SCR and IGBT.
4. Switching characteristics of MOSFET and TRIAC.
5. Single-phase half and fully controlled Rectifiers.
6. Single phase IGBT based Inverter performance verification
7. Design a buck converter and boost converter circuit using power MOSFET.
8. Analyze the performance of AC-AC Voltage controller.
9. Four quadrant operation of DC motor using chopper.
10. Three phase PWM inverters.
11. a. Simulation of Permanent magnet synchronous motor Using MATLAB Software.
    b. Simulation of Induction motor Using MATLAB Software.
12. Simulation of solar powered DC-DC converters

TOTAL : 45 PERIODS

COURSE OUTCOMES

CO's	OUTCOMES
The students will be able to:	
CO1	Design and analyze the performance characteristics of converter.
CO2	Design and analyze the performance characteristics of inverter.
CO3	Analyze the performance characteristics of AC voltage controller.
CO4	Analyze the performance characteristics of Permanent magnet synchronous motor.
CO5	Design, Simulate and analyze the induction motor.

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Reference Books:

1. SVHEC- POWER ELECTRONICS LABORATORY Manual.

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	1	-	-	-	-	3	-	-	-	3	3	-
CO2	3	-	1	1	-	-	-	-	3	-	-	-	3	3	-
CO3	3	-	2	2	-	-	-	-	3	-	-	-	3	1	-
CO4	2	-	3	3	-	-	-	-	3	-	-	-	3	1	-
CO5	3	-	-	2	-	-	-	-	3	-	-	-	3	1	-
Avg	2.6	-	2	1.8	-	-	-	-	3	-	-	-	3	2	-

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23EEL52	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To make the students familiarize with various representations of systems.
- To make the students analyze the stability of linear systems in the time domain and frequency domain.
- To make the students design compensator based on the time and frequency domain Specifications.
- To develop linear models mainly state variable model and transfer function model
- To make the students to design a complete closed loop control system for the physical systems.

List of Experiments

1. Determine the transfer function model of DC motor.
2. Analog (op amp based) simulation of linear differential equations.
3. Numerical Simulation of given nonlinear differential equations.
4. Stability analysis using Pole zero maps and Routh-Hurwitz Criterion in simulation platform.
5. Determination of transfer function of a physical system using frequency response and Bode's asymptotes.
6. Design of PID controllers and evaluation of closed loop performance. Vehicle.
7. Design of Lag, Lead and Lag-Lead Compensators
8. Position Control Systems

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	To model and analyze simple physical systems and simulate the performance in analog and digital platform.
CO2	To design and implement simple controllers in standard forms.
CO3	To design compensators based on time and frequency domain specifications..
CO4	To design a complete closed control loop and evaluate its performance for simple physical systems.
CO5	To analyze the stability of a physical system in both continuous and discrete domains.

Reference Books:

1. SVHEC- Control and Instrumentation Manual.
2. HANDBOOK FOR LAB MANUAL

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	-
CO2	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	-
CO3	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	-
CO4	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	-
CO5	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	-
Avg	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	-

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23EEE11	UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

Course Objectives:

- To study the generation, conservation of electrical power and energy efficient equipments.
- To understand the principle, design of illumination systems and energy efficiency lamps
- To study the methods of industrial heating and welding.
- To study the domestic utilization of electrical energy.

UNIT-I ILLUMINATION 9

Importance of lighting – properties of good lighting scheme – laws of illumination photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting.

UNIT-II REFRIGERATION AND AIR CONDITIONING 9

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-III HEATING AND WELDING 9

Role of electric heating for industrial applications – resistance heating – induction heating – dielectric heating - electric arc furnaces. Brief introduction to electric welding – welding generator, welding transformer and the characteristics.

UNIT-IV ENERGY CONSERVATION AND ITS IMPORTANCE 9

Energy conservation act 2001 and its Features-Review of Industrial Energy Conservation-Energy conservation in electrical Industries-Simulation study of energy conservation using power factor controller. (Three phase circuit simulation with and without capacitor)

UNIT-V DOMESTIC UTILIZATION OF ELECTRICAL ENERGY 9

House wiring - working principle of air conditioning system, Induction based appliances, Online and OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	To understand the main aspects of generation, utilization and conservation.
CO2	To identify an appropriate method of heating for any particular industrial application.
CO3	To evaluate domestic wiring connection and debug any faults occurred.
CO4	To construct an electric connection for any domestic appliance like refrigerator as well as to design a battery charging circuit for a specific household application
CO5	Ability to do electric connection for any domestic appliance like refrigerator, battery charging circuit for a specific household application.

TEXT BOOKS:

1. Wadhwa, C.L. "Generation, Distribution and Utilization of Electrical Energy", New Age International Pvt. Ltd, 2003.

2. Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.

3. Energy Efficiency in Electric Utilities, BEE Guide Book, 2010

REFERENCES:

1. Partab.H, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co, New Delhi, 2004.

2. Openshaw Taylor.E, "Utilization of Electrical Energy in SI Units", Orient Longman Pvt. Ltd, 2003.

3. Gupta.J.B, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2002.

Online Sources :

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	1.5	-	-	-	-	3	1	-
CO2	3	1	3	-	-	-	-	1.5	-	-	-	-	3	1	-
CO3	2	2	2	-	-	-	-	1.5	-	-	-	-	3	2	-
CO4	2	2	3	-	-	-	-	1.5	-	-	-	-	3	2	-
CO5	3	1	3	-	-	-	-	1.5	-	-	-	-	3	2	-
Avg	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**1.5**	**-**	**-**	**-**	**-**	**3**	**1.4**	**-**

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23EEE12	UNDERGROUND CABLE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- Understanding Power Cable Characteristics and Applications. Cable Manufacturing.
- Installation of underground power cables
- Underground cable System Fault Locating.
- Testing and maintenance of Underground cable system.
- Cable Performance and Field Assessment of Power Cables

UNIT-I INTRODUCTION TO ELECTRICAL POWER CABLES 9

Introduction 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

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.

UNIT-III SUPPLY DISTRIBUTION SYSTEMS AND CABLES 9

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.

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.

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.

TOTAL:45PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Ability to understand the fundamental of underground cable system.
CO2	Ability to gain knowledge on the architecture of UG cable and physical and electrical characteristics of the UG cable.
CO3	Ability to understand different types of cable used in distribution system
CO4	Ability to acquire knowledge on Underground cables used in transmission system
CO5	Ability to understand the cable installations procedures and practices.

TEXT BOOKS:

1. William Thue, 'Electrical Power Cable Engineering', CRC Press Taylor & Francis Group., 6000 Broken Sound Parkway NW, Suite 300Boca Raton, FL 33487-2742, 3 rd Edition 2017.
2. G. F. Moore, 'Electric Cables Handbook' -Third edition, Blackwell Science Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK., January 2017.

REFERENCES:

1. Leonard L. Grigsby, 'Electrical Power Cable Engineering' - CRC Press, Marcel Dekker, 3rd Edition 2012.
2. Christian Flytkjaer Jensen, Online Location of Faults on AC Cables in Underground Transmission Systems (Springer Theses), 2014, March. 121
3. https://kafactor.com/content/technical-resources/kerite-underground-cable-engineeringhandbook.pdf 4. Handbook on Cable Fault Localization (April 2020).

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	2	1	-	3	2	-	3	-	-
CO2	3	2	3	-	-	-	2	1	-	3	2	-	3	-	-
CO3	3	2	2	-	-	-	2	1	-	3	2	-	3	3	-
CO4	3	2	3	-	-	-	2	1	-	3	2	-	3	3	-
CO5	3	3	3	-	-	-	2	1	-	3	2	-	3	3	-
Avg	**3**	**2**	**2**	**-**	**-**	**-**	**2**	**1**	**-**	**3**	**2**	**-**	**3**	**1.4**	**-**

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23EEE13	SUBSTATION ENGINEERING AND AUTOMATION	L	T	P	C
		3	0	0	3

Course Objectives:

- To Know the Holistic Understanding of Substation Engineering and Design
- To understand the Practical Aspects of Substation Engineering
- Course aims to enhance the knowledge, and give the practical guidelines for site selection, construction, protection along with maintenance, safety in a substation.
- To study the Guidelines for Site Selection, Construction, Protection, Maintenance, and Safety.

UNIT-I **SUBSTATION DESIGN DEVELOPMENT** **9**

Substation Introduction and Classifications, Different bus bar switching schemes for Substation. Standards and Practices, Factors Influencing Substation Design - Altitude, Ambient Temperature, Earthquake and seismic zones, pollution and corrosion.

UNIT-II **SUBSTATION EQUIPMENT** **9**

Selection and sizing of main substation equipment: Transformer, Isolator, Circuit Breaker, surge arrestor, Instrument transformers, classification of equipment with a practical overview, and the performance parameters. Classifications of MV Switchgear and Key Design Parameters, MV/LV Switchgear construction and design of control scheme. Station Auxiliary equipment.

UNIT-III **PROTECTION AND SUBSTATION AUTOMATION** **9**

Power System protection, Over current and Earth Fault protection and coordination. Distribution Feeder Protection, Transformer – Unit/Main Protection, Familiarization of NUMERICAL Relays, distance/differential protection for transmission line. Substation Automation.

UNIT-IV **SUBSTATION DESIGN & LAYOUT ENGINEERING** **9**

Layout aspects of Outdoor Air Insulated Substation and GIS: Statutory Clearances, Equipment Layout engineering aspects for Outdoor Substation/GIS and related calculations, and guide lines, Cable routing layout, Erection Key Diagram (EKD), switchyard earthing design as per IEEE80

UNIT-V **INTERFACE ENGINEERING** **9**

Fire Detection, Alarm System and Fire Suppression System for transformer, Heating, Ventilation and Air-conditioning (HVAC) for Substation.

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	To Understand the key deciding factors involved in substation design and operation.
CO2	To Know about the sizing and selection of equipment this forms part of substation.
CO3	To Know about composite layout design aspects of the substation with different services.
CO4	To Understand about Interdisciplinary aspects involved in substation design.
CO5	Understand different protection and control scheme involved in substation design.

TEXT BOOKS:

1. Sunil S. Rao, "Switchgear Protection and Power Systems (Theory, Practice & Solved Problems)", Khanna Publications, 14th Edition, 2019.

2. Electrical substation and engineering & practice by S.Rao, 3rd Edition, Khanna Publishers 2015 3. Energy Efficiency in Electric Utilities, BEE Guide Book, 2010.

REFERENCES

1. Manual on Substation by Central Board of irrigation and Power (CBIP) Publication No 342., 2006.

2. Substation automation system Design and implementation by Evelio Padilla by Wiley Publications, 1st Edition, 2015 November.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	-	-	-	-	2	-	-	-	-	3	1	-
CO2	3	1	3	-	-	-	-	1	-	-	-	-	3	1	-
CO3	3	2	2	-	-	-	-	1	-	-	-	-	3	1	-
CO4	3	2	3	-	-	-	-	2	-	-	-	-	3	1	-
CO5	3	1	3	-	-	-	-	1	-	-	-	-	3	1	-
Avg	2.6	2	2	-	-	-	-	1.3	-	-	-	-	3	1	-

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23EEE14	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand real power control and operation
- To know the importance of frequency control
- To analyze different methods to control reactive power
- To understand unit commitment problem and importance of economic load dispatch
- To understand real time control of power systems

UNIT-I **LOAD FREQUENCY CONTROL** **9**

Basics of speed governing mechanism and modeling – speed - load characteristics – load sharing between two synchronous machines in parallel. Control area concept. Load Frequency Control of a single area system. Static and dynamic analysis of uncontrolled and controlled cases. Integration of economic dispatch control with LFC. Two - area system – modeling.

UNIT-II **REACTIVE POWER VOLTAGE CONTROL** **9**

Basics of reactive power control, Excitation systems – modelling. Static and dynamic analysis: stability compensation generation and absorption of reactive power. Methods of voltage control – tap changing transformer. System level control using generator voltage magnitude setting.

UNIT-III **ECONOMIC OPERATION OF POWER SYSTEMS** **9**

Statement of economic dispatch problem – cost of generation-Incremental cost curve - co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. Economic Aspects of Power Generation.

UNIT-IV **UNIT COMMITMENT** **9**

Statement of Unit Commitment problem – constraints, spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints. Solution methods.

UNIT-V **COMPUTER CONTROL OF POWER SYSTEMS** **9**

Need for computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions – SCADA and EMS functions.

TOTAL:45PERIODS

COURSE OUTCOMES

The students will be able to:

CO1	Know importance of frequency and real power control.
CO2	Know the reactive power control methods and importance of reactive power
CO3	Compare unit commitment and economic dispatch and their importance.
CO4	Understand real time control of power systems.
CO5	Analyze various functions of Energy Management System (EMS) functions.

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TEXT BOOKS:

1. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Ltd, New Delhi, 30th reprint,2007.

REFERENCE BOOKS:

1. Chakrabarti & Haldar, "Power System Analysis: Operation and Control", Prentice Hall of India, 2004 Edition.
2. C.L.Wadhwa, 'Power System Analysis', New Age International- 6th Edition, 2010,
3. Robert Miller, James Malinowski, 'Power System Operation', Tata McGraw Hill Publishing Company Ltd, New Delhi, 3E, JUN-09.
4. P. Kundur, Neal J. Balu, 'Power System Stability & Control', IEEE, 1998.
5. Power System Analysis by Hadi Saadat – TMH Edition.

ONLINE SOURCES

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	2	-	3	2	2
CO2	3	3	2	2	1	-	-	-	-	-	2	-	3	2	2
CO3	3	3	2	2	1	-	-	-	-	-	2	-	3	2	2
CO4	3	3	2	2	1	-	-	-	-	-	2	-	3	2	2
CO5	2	3	2	2	1	-	-	-	-	-	2	-	3	2	2
Avg	2.8	3	2	2	1	-	-	-	-	-	2	-	3	2	2

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23EEE15	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

Course Objectives:

- To study the concepts behind economic analysis and Load management.
- To understand the basics of materials and energy balance.• To analyze the energy efficiency in thermal utilities
- To know the concept of compressed air system.
- To illustrate the concept of lighting systems and cogeneration.

UNIT-I **ENERGY SCENARIO** **9**

Basics of Energy and its various forms - Conventional and non-conventional sources - Energy policy - Energy conservation act 2001, Amedments (India) in 2010 - Need for energy management- Designing and starting an energy management program.

UNIT-II **ENERGY COST AND LOAD MANAGEMENT** **9**

Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- Cost of electricity-Loss evaluation- Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification.

UNIT-III **ENERGY MANAGEMENT** **9**

Demand side management (DSM)– DSM planning – DSM techniques – Load management as a DSM strategy – Energy conservation – Tariff options for DSM

UNIT-IV **ENERGY AUDITING** **9**

Definition – Energy audit methodology: audit preparation, execution and reporting – Financial analysis.

UNIT-V **ENERGY EFFICIENT TECHNOLOGIES** **9**

Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager – employees training and planning.

TOTAL:45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Students able to acquire knowledge in the field of energy management and auditing process.
CO2	Learned the about basic concepts of economic analysis and load management
CO3	Able to design the effective thermal utility system.
CO4	Able to improve the efficiency in compressed air system.
CO5	Acquired the design concepts in the field of lighting systems, light sources and various forms of cogeneration.

TEXT BOOKS:

1. Anil Kumar, ,Om Prakash,Prashant Singh Chauhan"Energy Management: Conservation and Audits, CRC Press, 2020.
2. S.C. Bhatia and Sarvesh Devraj, "Energy Conservation", Woodhead Publishing India Pvt. Ltd, 2016.

REFERENCES:

1. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", CRC press, Taylor & Francis group, Eighth Edition, 2016.
2. https://prsindia.org/files/bills_acts/bills_parliament/2010/The_Energy_Conservation_Amendme nt_Bill_2010.pdf
3. Eastop T.D and Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, 1990.

Online Sources:

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	1	-	-	1	-	-	-	2	2	3	-
CO2	3	-	-	2	3	-	-	1	-	-	-	2	2	3	-
CO3	3	-	-	-	1	-	-	1	-	-	-	2	2	3	-
CO4	3	3	-	-	3	-	-	1	-	-	-	2	2	3	-
CO5	3	-	-	2	1	-	-	1	-	-	-	2	2	3	-
Avg	**3**	**2.5**	**-**	**2**	**1.8**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**2**	**3**	**-**

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23EEE16	POWER QUALITY	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn the basic definitions in Power Quality.
- To study the power quality issues in Single Phase and Three Phase Systems.
- To understand the principles of Power System Harmonics.
- To know the way to use DSTATCOM for Harmonic Mitigation.
- To learn the concepts related with Series Compensation.

UNIT-I INTRODUCTION 9

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non-linear and unbalanced loads.

UNIT-II ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM 9

Single phase linear and non-linear loads – single phase sinusoidal, non-sinusoidal source – supplying linear and nonlinear loads – three phase balanced system – three phase unbalanced system.

UNIT-III MITIGATION OF POWER SYSTEM HARMONICS 9

Introduction - Principle of Harmonic Filters – Series-Tuned Filters – Double Band-Pass Filters – damped Filters – Detuned Filters – Active Filters – Power Converters – Harmonic Filter Design – Tuned Filter – Second-Order Damped Filter.

UNIT-IV LOAD COMPENSATION USING DSTATCOM 9

Generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM.

UNIT-V SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM 9

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – Voltage Restoration – Series Active Filter – Unified Power Quality Conditioner.

TOTAL : 45PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Use various definitions of power quality for power quality issues
CO2	Describe the concepts related with single phase / three phase, linear / nonlinear loads and single phase / three phase sinusoidal, non-sinusoidal source
CO3	Solve problems related with mitigation of Power System Harmonics
CO4	Use DSTATCOM for load compensation
CO5	Demonstrate the role of DVR, SAFs UPQC in power distribution systems

TEXTBOOKS:

1. Arindam Ghosh and Gerad Ledwich "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, First Edition,2002

2. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, Second Edition, 2011.

3. George J. Wakileh, "Power System Harmonics – Fundamentals, Analysis and Filter Design", Springer – Verlag Berlin Heidelberg, New York, 2019.

REFERENCES:

1. R.C.Duggan "Electric Power Systems Quality", Tata MC Graw Hill Publishers, Third Edition, 2012.

2. Arrillga "Power System Harmonics", John Wiely and Sons, 2003 2nd Edition.

3. Derek A.Paice "Power Electronic Converter Harmonics" IEEE Press, 1995, Wiley – IEE Press 1999, 18th Edition.

Online Sources :

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	3	3	-	3	-	-	3	3	-
CO2	3	3	3	3	-	-	3	3	-	3	-	-	3	3	-
CO3	3	3	3	3	-	-	3	3	-	3	-	-	3	3	-
CO4	3	3	3	3	-	-	3	3	-	3	-	-	3	3	-
CO5	3	3	3	3	-	-	3	3	-	3	-	-	3	3	-
Avg	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**-**

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23EEE17	SMART GRID	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the various challenges and benefits of smart grid and the national
- To understand the evolution of Smart and Interconnected energy systems.
- To understand the various computing technologies for Smart Operation of the Grid
- To get an insight of the various smart measurement technologies.
- To understand the concepts related with transmission and distribution in smart grid technologies.

UNIT-I INTRODUCTION 9

Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.

UNIT-II SMART METERING 9

Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit.

UNIT-III SMART GRID TECHNOLOGIES (Transmission) 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.

UNIT-IV SMART GRID TECHNOLOGIES (Distribution) 9

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.

UNIT-V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

The students will be able to:

CO1 Understand the importance and objectives of Power System Grid

CO2 Know and understand the concept of a smart grid

CO3 Identify and discuss smart metering devices and associated technologies.

CO4 Get an overview of Microgrid and Electric Vehicle Technology.

CO5 Have an up to date knowledge on the various computing technologies.

TEXT BOOKS:

1. Smart Grids Advanced Technologies and Solutions, Second Edition, Edited by Stuart Borlase,CRC, 2018.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley,2012.
3. James Momoh ,Smart Grid Fundamentals of Design and Analysis, IEEE press 2012.

REFERENCES:

1. Ahmed F. Zobaa, Trevor J. Bihl, Big data analytics in future power systems, 1st Edition, CRC press 2018.
2. C. Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," in IEEE Transactions on Industrial Informatics, vol. 7, no. 4, pp. 529-539, Nov. 2011.doi: 10.1109/TII.2011.2166794.

Online Sources :

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	-	-	1	-	3	-	2	3	3	-
CO2	2	3	2	3	3	-	-	1	-	3	-	2	3	3	-
CO3	3	3	2	3	3	-	-	1	-	3	-	1	3	3	-
CO4	2	3	2	3	3	-	-	1	-	3	-	2	3	3	-
CO5	3	3	2	3	3	-	-	1	-	3	-	1	3	3	-
Avg	**2.8**	**3**	**2**	**3**	**3**	**-**	**-**	**1**	**-**	**3**	**-**	**1.8**	**3**	**3**	**-**

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23EEE18	RESTRUCTED POWER MARKET	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the process of restructuring of power industry.
- Describe the technical and non-technical issues in deregulated power industry.
- Classify different market mechanisms and summarize the role of various entities in the market. Analyze the energy and ancillary services management in deregulated power industry.
- Understand the restructuring framework US and Indian power sector.

UNIT-I INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY AND FUNDAMENTALS OF ECONOMICS **9**

Introduction, reasons for restructuring / deregulation of power industry, understanding the restructuring process, Introduction to issues involved in deregulation, Reasons and objectives of deregulation of various power systems across the world, Consumer behavior.

UNIT-II THE PHILOSOPHY OF MARKET MODELS AND MARKET POWER AND GENERATORS BIDDING: **9**

Introduction, Market models based on contractual arrangements, Comparison of various market models, Electricity vis-à-vis other commodities, Market architecture, Attributes of a perfectly competitive market, the firm's supply decision under perfect competition.

UNIT-III TRANSMISSION CONGESTION MANAGEMENT, FINANCIAL TRANSMISSION RIGHTS **9**

Introduction, Classification of congestion management methods, Calculation of ATC, Non-market methods, Market based method, Nodal pricing, Inter-zonal Intra-zonal congestion management, Price area congestion management.

UNIT-IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK **9**

Types of ancillary services - Load-generation balancing related services - Voltage control and reactive power support services - Black start capability service - Mandatory provision of ancillary services - Markets for ancillary services.

UNIT-V REFORMS IN INDIAN POWER SECTOR **9**

Introduction, Framework of Indian power sector, Reform initiatives during 1990-1995, the availability based tariff (ABT), The Electricity Act 2003, Open Access issues.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Describe the requirement for deregulation of the electricity market and the philosophy of various market models.
CO2	Analyze the locational marginal pricing and financial transmission rights.
CO3	Analyze the ancillary service management.
CO4	Analyze transmission pricing paradigm.
CO5	Understand the evolution of deregulation in Indian power sector.

TEXT BOOKS:

1. Kankarbhattacharya, Math H.J. Bollen & Jaap E. Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publishers, 2001..
2. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility" Marcel Dekker Pub., 2001, 1st Edition.

REFERENCES:

1. Sally Hunt, "Making competition work in electricity", JohnWilley and Sons Inc. 2002.
2. Steven Stoft, Power System Economics: Designing Markets for Electricity", Wiley-IEEE Press, 2002.
3. 3. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016, 3rd Edition.

Online Sources :

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	1	2	3	-	-
CO2	3	2	1	-	-	1	-	-	-	-	1	2	3	-	-
CO3	3	2	1	-	-	1	-	-	-	-	1	2	3	-	-
CO4	3	2	1	-	-	1	-	-	-	-	1	2	3	-	-
CO5	3	-	1	-	-	1	-	-	-	-	1	2	3	-	-
Avg	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**3**	**-**	**-**

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23EEE21	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the working of special machines like Synchronous reluctance motor stepper motor, switched reluctance motor, BLDC motor & PMSM
- To derive torque equation and study the characteristics of special machines
- To design the controller for special machines
- To study the working principle of synchronous reluctance motor
- To simulate closed loop operation of BLDC motor

UNIT-I SYNCHRONOUS RELUCTANCE MOTORS 6

Constructional features – Axial and radial air gap motors – Operating principle – Reluctance Torque – Phasor diagram - Characteristics – Vernier motor.

UNIT-II STEPPER MOTOR 6

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations– Theory of torque predictions – Linear and non-linear analysis – Characteristics – Drive circuits – Applications- Microprocessor based control.

UNIT-III SWITCHED RELUCTANCE MOTORS 6

Constructional features – principle of operation – static torque production – energy conversion loop – effect of saturation – torque speed characteristics – power converters and their controllers – rotor position sensing – closed loop control of SRM –applications.

UNIT-IV PERMANENT MAGNET BRUSHLESS DC MOTORS 6

Necessity for brushless DC motor- Principle of operation – Types-Three phase unipolar and bipolar driven motors-Rotor position sensors- construction of Commutator– EMF equations-Torque equations – Power controllers – torque /speed characteristics – Applications.

UNIT-V PERMANENT MAGNET SYNCHROUNOUS MOTORS 6

Construction and types, Principle of operation, EMF and Torque equation, Phasor diagram, Torque Speed Characteristics, Power controllers- Self control, Vector control, Microprocessor Based Control, Applications.

TOTAL : 30 PERIODS

LAB COMPONENT: 30 PERIODS

Using electromagnetic software

1) Simulation of Synchronous Reluctance motor
2) Simulation of Stepper motor
3) Simulation of SRM
4) Simulation of PMBLDC motor
5) Simulation of PMSM

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TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES

The students will be able to:

CO1	Ability to model and analyze power electronic systems and equipment using computational software.
CO2	Ability to optimally design magnetic required in special machines based drive systems using FEM based software tools.
CO3	Ability to analyse the dynamic performance of special electrical machines.
CO4	Ability to understand the characteristics of special electrical machines.
CO5	Ability to design and conduct experiments towards research.

Text Books:

1. Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2008.
2. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives
3. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives -CRC Press, Marcel Applications -CRC Press 2009

Reference Books:

1. T.Kenjo, ' Stepping motors and their microprocessor controls', Oxford University press, New Delhi, 2000 Dekker 2009.
2. T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Clarendon press, London, 1989.
3. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, and Applications -CRC Press 2017.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	1	-	1	-	1	3	2	1
CO2	3	3	3	3	-	-	2	1	-	2	-	3	3	3	3
CO3	3	-	-	-	-	-	-	1	-	1	-	1	3	3	3
CO4	3	3	3	3	-	-	-	1	-	3	-	3	3	3	3
CO5	3	3	3	3	-	-	3	1	-	3	-	3	3	3	3
Avg	**3**	**1.8**	**1.8**	**1.8**	**-**	**-**	**1**	**1**	**-**	**2**	**-**	**2.2**	**3**	**2.8**	**2.6**

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23EEE22	ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
		2	0	2	3

Course Objectives:

- To model & simulate all types of DC machines
- To develop reference frame equations for various elements like R, L and C
- To model an induction (three phase and 'n' phase) and synchronous machine
- To drive reference frame equations for induction and synchronous machine
- To study the need and working of multiphase induction and synchronous machine

UNIT-I MODELING OF BRUSHED-DC ELECTRIC MACHINERY 6

Fundamentals of Operation - Introduction - Governing equations and modeling of Brushed DC-Motor -Shunt, Series and Compound - State model derivation - Construction of Model of a DC Machine using state equations- Shunt, Series and Compound.

UNIT-II REFERENCE FRAME THEORY 6

Historical background - phase transformation and commutator transformation - transformation of variables from stationary to arbitrary reference frame

UNIT-III INDUCTION MACHINES 6

Three phase induction machine - equivalent circuit- free acceleration characteristics - voltage and torque equations in machine variables and arbitrary reference frame variables - Simulation under noload and load conditions- Machine variable form, arbitrary reference variable form.

UNIT-IV SYNCHRONOUS MACHINES 6

Three phase synchronous machine - voltage and torque equations in machine variables and rotor reference frame variables (Park's equations).

UNIT-V MULTIPHASE (MORE THAN THREE-PHASE) MACHINES CONCEPTS 6

Preliminary Remarks - Necessity of Multiphase Machines --Evolution of Multiphase Machines-Advantages of Multiphase Machines - Working Principle - Multiphase Induction Machine, Multiphase Synchronous Machine -Modeling of 'n' phase machine. Applications of Multiphase Machines.

TOTAL : 30 PERIODS

LAB COMPONENT: 30 PERIODS

1) Modeling of DC machines.
2) Simulation under no-load and loaded conditions for a PMDC motor
3) Simulation of smooth starting for DC motor.
4) Simulation under no-load and load conditions of a three phase induction machine in machine variable form and arbitrary reference variable form.
5) Simulation under no-load and load conditions of a three phase synchronous machine in machine variable form and arbitrary reference variable form.

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Find the modeling for a brushed DC-Motor (Shunt, Series, Compound and separately excited motor) and to simulate DC motors using state models
CO2	Apply reference frame theory for, resistive and reactive elements (three phase)
CO3	Compute the equivalent circuit and torque of three phase induction motor and synchronous motor in machine variable arbitrary reference frame variable
CO4	Find the need and advantages of multiphase machines
CO5	Demonstrate the working of multiphase induction and synchronous machine.

Text Books:

1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition, 2020.
2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011, 1st Edition.
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek, "Analysis of Electric Machinery and Drive Systems, 3rd Edition, Wiley-IEEE Press, 2013.

Reference Books:

1. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson Education, 1st Imprint, 2015, 1st Edition.
2. R.Ramanujam, Modeling and Analysis of Electrical Machines, I.k.International Publishing House Pvt.Ltd,2018.
3. Atif Iqbal,Shaikh Moinoddin, Bhimireddy Prathap Reddy, Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Wiley,2021,1st Edition

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	2	1	-	3	-	2	3	3	2
CO2	3	3	3	3	3	-	2	1	-	3	-	2	3	3	3
CO3	3	3	3	3	3	-	2	1	-	3	-	2	3	3	3
CO4	3	-	-	-	3	-	2	1	-	3	-	2	3	3	3
CO5	3	-	-	-	3	-	2	1	-	3	-	2	3	3	3
Avg	**3**	**1.8**	**1.8**	**1.8**	**3**	**-**	**2**	**1**	**-**	**3**	**-**	**2**	**3**	**3**	**2.8**

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23EEE23	MULTILEVEL POWER CONVERTERS	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
- To study the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI.
- To study the working of MLI with reduced switch count.
- To simulate three level diode clamped MLI and three level flying capacitor based MLI with resistive and reactive load
- To simulate the MLI with reduced switch count.

UNIT-I MULTILEVEL TOPOLOGIES 6

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 6

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

UNIT-III DIODE CLAMPED MULTILEVEL CONVERTER 6

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 6

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

UNIT-V MULTILEVEL CONVERTER WITH REDUCED SWITCH COUNT 6

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

TOTAL : 30 PERIODS

LAB COMPONENT: 30 PERIODS

1) Simulation of Fixed PWM, Sinusoidal PWM for an inverter.
2) Simulation of H bridge inverter with R load.
3) Simulation of three level diode clamped MLI with R load.
4) Simulation of three level capacitor clamped MLI with R load.
5) Simulation of MLI with reduced switch configuration.

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Examine the different topologies of multilevel inverters (MLIs) with and without DC link capacitor.
CO2	Examine the performance of MLIs with Bipolar Pulse Width Modulation (PWM) Unipolar PWM Carrier-Based PWM Schemes Phase Level Shifted Multicarrier Modulation
CO3	Demonstrate the working principles of Cascaded H-Bridge MLI, diode clamped MLI, flying capacitor MLI and MLI with reduced switch count
CO4	Analyze the voltage balancing performance in Diode clamped MLI.
CO5	Simulate three level, capacitor clamed and diode clamped MLI with R and RL load.

Text Books:

1. Rashid M.H,"Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2014 Pearson 4th edition.
2. Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla,"Multilevel Converters for Industrial Applications", CRC Press, 22-Jul-2013, 20171st Edition.
3. BinWu, Mehdi Narimani,High Power Converters and AC drives by IEEE press 2017, 2nd Edition.

Reference Books:

1. Fang Lin Luo, Hong Ye,Advanced DC/AC Inverters: Applications in Renewable Energy, CRC Press, 22-Jan-2013, 2017, 1st Edition.
2. Hani Vahedi, Mohamed Trabelsi, Single-DC-Source Multilevel Inverters, Springer, 2019, 1st Edition.
3. Ersan Kabalcı, Multilevel Inverters Introduction and Emergent Topologies, Academic Press Inc, 2021, 1st Edition

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	-	-	2	-	-	3	-	3	3	3	-
CO2	3	2	2	3	-	-	2	-	-	3	-	3	3	3	-
CO3	3	2	2	3	-	-	2	-	-	2	-	3	3	3	-
CO4	3	3	3	3	-	-	2	-	-	3	-	2	3	2	-
CO5	3	3	3	3	3	-	2	-	-	3	-	3	3	3	-
Avg	**3**	**2.4**	**2.4**	**3**	**3**	**-**	**2**	**-**	**-**	**2.8**	**-**	**2.8**	**3**	**2.8**	**-**

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23EEE24	HVDC AND FACTS	L	T	P	C
		3	0	0	3

Course Objectives:

- The problems in AC transmission systems and DC transmission systems
- The operation and control of SVC and TCSC
- The concepts of IGBT based FACTS controllers
- The basic operation Line Commutated Converter(LCC) based HVDC links
- The features of voltage source converter based HVDC link.

UNIT-I INTRODUCTION 9

Reactive power control in electrical power transmission lines–load & system compensation, Uncompensated transmission line–shunt and series compensation. Need for HVDC Transmission, Comparison between AC & DC Transmission-Types of HVDC transmission System.

UNIT-II STATIC VAR COMPENSATOR (SVC) AND THYRISTOR CONTROLLED SERIES COMPENSATOR (TCSC) 9

VI characteristics of FC+TSR, TSC+TSR, Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator, Thyristor Controlled Series Compensator (TCSC).

UNIT-III 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.

UNIT-IV LINE COMMUTATED HVDC TRASMISSION 9

Operation of Gratz bridge - Effect of delay in Firing Angle – Effect of commutation overlap - Equivalent circuit, Basic concept of HVDC transmission. Model of operations and control of power flow CC.

UNIT-V VSC BASED HVDC TRANSMISSION 9

Basic 2 level IGBT inverter operation- 4 Quadrant operation- phase angle control- dq control- Control of power flow in VSC based HVDC Transmission, Topologies of MTDC system.

TOTAL:45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	To Identify and understand the problems in AC transmission systems and understand the need for Flexible AC transmission systems and HVDC Transmission
CO2	To understand the operation and control of SVC and TCSC and its applications to enhance the stability and damping.
CO3	To Analyze basic operation and control of voltage source converter based FACTS controllers
CO4	To demonstrate basic operation and control of Line Commutated HVDC Transmission
CO5	To explain the d-q control based operation of VSC based HVDC Transmission

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma ,"Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2002.
2. Narain G.Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors,Delhi-110006,2011.

REFERENCES:

1. K.R.Padiyar,"FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T.John,"FlexibleA.C.TransmissionSystems",InstitutionofElectricalandElectronic Engineers(IEEE), 1999.
3. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

Online Sources :

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	1	-	-	-	-	-	-	-	2	3	-
CO2	2	3	1	2	3	-	-	-	-	-	-	-	2	3	-
CO3	2	3	1	3	1	-	-	-	-	-	-	-	2	3	-
CO4	3	3	1	3	3	-	-	-	-	-	-	-	2	3	-
CO5	3	3	1	2	1	-	-	-	-	-	-	-	2	3	-
Avg	**2.5**	**3**	**1**	**2.5**	**1.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**

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23EEE25	SMPS AND UPS	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn the working of isolated & non-isolated DC-DC converters
- To design isolated & non-isolated DC-DC converters.
- To drive the equations related with converter dynamics.
- To design and simulate P, PI & PID controller for buck, boost and buck-boost converters.
- To identify and study different configurations of the UPS

UNIT-I ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS 6

Basic topologies: Buck, Boost and Buck-Boost - Principles of operation – Continuous conduction mode– Concepts of volt-sec balance and charge balance – Analysis and design based on steady-state relationships – Introduction to discontinuous conduction mode.

UNIT-II ANALYSIS OF ISOLATED DC-DC CONVERTERS 6

Introduction - classification- forward- flyback- pushpull – half bridge – full bridge topologies- C'uk converter as cascade combination of boost followed by buck – isolated version of C'uk converter - design of SMPS.

UNIT-III CONVERTER DYNAMICS 6

AC equivalent circuit analysis – State space averaging – Circuit averaging – Transfer function model for buck, boost and buck-boost converters – Simulation of basic topologies using state space model derived – Comparison with the circuit model based simulation already carried out.

UNIT-IV CONTROLLER DESIGN 6

Review of P, PI, and PID control concepts – gain margin and phase margin – Bode plot based analysis – Design of controller for buck, boost and buck-boost converters.

UNIT-V POWER CONDITIONERS AND UPS 6

Introduction – Power line disturbances – Power conditioners – UPS: Offline and On-line – Need for filters – Filter for PWM VSI – Front-end battery charger – boost charger.

TOTAL: 30 PERIODS

LAB COMPONENT: 30 PERIODS

1) Simulation of Basic topologies.
2) Simulation of bidirectional DC DC converter (both non-isolated and isolated) considering EV as an example application.
3) Simulation of basic topologies using state space model derived – Comparison with the circuit model based simulation already carried out.
4) Simulation study of controller design for basic topologies.
5) Simulation of battery charger for EV applications.

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Demonstrate the working of buck, boost and buck- boost converters in continuous and discontinuous conduction mode.
CO2	Build buck/boost converters using suitable design method.
CO3	Analyze the behaviors of isolated DC-DC converters and to design SMPS for battery operated vehicle.
CO4	Compute state space averaged model and transfer function for buck, boost and buck- boost converters.
CO5	Demonstrate the P, PI and PID controller performance analytically and by simulation for buck boost and buck- boost converters.

Text Books:

1. Robert W. Erickson & Dragon Maksimovic, " Fundamentals of Power Electronics", Third Edition, 2020
2. Ned Mohan," Power Electronics: A First Course", Johnwiley, 2013.

Reference Books:

1. Marian K. Kazimierczuk and Agasthya Ayachit,"Laboratory Manual for Pulse-Width Modulated DC–DC Power Converters", Wiley 2016.
2. Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press, 2002.
3. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	-	-	3	3	-	2	-	-	3	3	-
CO2	3	2	2	3	-	-	3	3	-	2	-	-	3	2	-
CO3	3	3	2	2	-	-	3	-	-	3	-	-	3	3	-
CO4	3	2	2	3	-	-	-	-	-	2	-	-	3	3	-
CO5	3	3	2	3	-	-	3	3	-	3	-	-	3	3	-
Avg	**3**	**2.4**	**2**	**2.8**	**-**	**-**	**3**	**3**	**-**	**2.4**	**-**	**-**	**3**	**2.8**	**-**

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23EEE26	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn the various types of renewable sources of energy.
- To understand the electrical machines to be used for wind energy conversion systems.
- To learn the principles of power converters used in solar PV system.
- To study the principle of power converters used in Wind system.
- To simulate the AC-DC, AC-AC Converters, Matrix Converters and PWM Inverters.

UNIT-I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS 6

Classification of Energy Sources – Importance of Non-conventional energy sources – Advantages and disadvantages of conventional energy sources - Environmental aspects of energy - Impacts of renewable energy generation on the environment- Solar Photovoltaic (PV), Fuel cells, Wind Energy

UNIT-II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS 6

Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT-III POWER CONVERTERS 6

Power Converters: Line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Simulation of line commutated converters, buck/boost converters.

UNIT-IV POWER CONVERTERS FOR WIND SYSTEMS 6

Power Converters: Three-phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid-Interactive Inverters - Matrix converter.

UNIT-V HYBRID RENEWABLE ENERGY SYSTEMS 6

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind-PV, Micro hydel-PV, Biomass-Diesel systems - Maximum Power Point Tracking (MPPT).

TOTAL : 30 PERIODS

LAB COMPONENT: 30 PERIODS

1) Simulation on modelling of Solar PV System- V I Characteristics
2) Simulation on Modelling of fuel cell- V I Characteristics
3) Simulation of self- excited Induction Generator.
4) Simulation of DFIG/ PMSG based Wind turbine.
5) Simulation on Grid integration of RES.

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TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES

The students will be able to:

CO1	Examine the available renewable energy sources.
CO2	Demonstrate the working principles of electrical machines and power converters used for wind energy conversion system
CO3	Demonstrate the principles of power converters used for solar PV systems
CO4	Examine the available hybrid renewable energy systems.
CO5	Simulate AC-DC converters, buck/boost converters, AC-AC converters and PWM inverters

Text Books:

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009, 7th impression.
2. Rashid .M. H "Power electronics Hand book", Academic press,2nd Edition, 2006 4th Edition, 2017
3. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.

Reference Books:

1. Rai. G.D," Solar energy utilization", Khanna publishers, 5th Edition, 2008.
2. Gray, L. Johnson, "Wind energy system", prentice hall of india, 2nd Edition, 2006.
3. H.Khan "Non-conventional Energy sources ",Tata McGraw-hill Publishing Company, New Delhi, 2017, 3rd Edition.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	-	2	-	2	3	3	-
CO2	3	-	2	-	-	-	-	-	-	2	-	2	3	2	-
CO3	3	-	2	-	-	-	-	-	-	2	-	2	3	3	-
CO4	3	-	3	-	-	-	-	-	-	2	-	2	3	3	-
CO5	3	3	2	3	3	-	-	3	-	2	-	3	3	3	-
Avg	**3**	**3**	**2.2**	**3**	**3**	**-**	**-**	**3**	**-**	**2**	**-**	**2.2**	**3**	**2.8**	**-**

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23EEE27	CONTROL OF POWER ELECTRONICS CIRCUITS	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn the basics of control system simulation.
- To do symbolic calculation.
- To study the principles of sliding mode control and the way of apply smc for buck converter.
- To learn the concept of power factor correction.
- To design simulate smc for buck converter and power factor correction circuit with controller.

UNIT-I SIMULATION BASICS IN CONTROL SYSTEMS 6

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions)

UNIT-II SYMBOLIC CALCULATIONS 6

Symbolic Variables - Symbolic Vector Variables, Commands for Handling Polynomial Expressions- Extracting Parts of a Polynomial -. Factorization and Roots of Polynomials, Symbolic Matrix Algebra - Operations with Symbolic Matrices - Other Symbolic Matrix Operations.

UNIT-III SLIDING MODE CONTROL BASICS 6

Introduction- Introduction to Sliding-Mode Control- Basics of Sliding-Mode Theory- Application of Sliding-Mode Control to DC-DC Converters—Principle-Sliding mode control of buck converter

UNIT-IV POWER FACTOR CORRECTION CIRCUITS 6

Introduction, Operating Principle of Single-Phase PFCs, Control of boost converter based PFCs, Designing the Inner Average-Current-Control Loop, Designing the Outer Voltage-Control Loop, Example of Single-Phase PFC Systems.

UNIT-V CONTROLLER DESIGN FOR PFC CIRCUITS 6

Power factor correction circuit using other SMPS topologies: C'uk and SEPIC converter - PFC circuits employing bridgeless topologies

TOTAL : 30 PERIODS

LAB COMPONENT: 30 PERIODS

1) Simulation exercises on zero, first and second order basic blocks.
2) Simulation exercises based on symbolic calculations.
3) Simulation of Sliding mode control based buck converter.
4) Simulation of Single-Phase PFC circuit employing boost converter.
5) Simulation of Single-Phase PFC circuit employing C'uk converters.

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	To calculate transfer function for constant, differential, integral, First order and Second order factors.
CO2	To illustrate the effect of poles and zero's in the 's' plane
CO3	To select Symbolic equations for solving problems related with Matrices, Polynomial and vectors
CO4	To compute the control expression for DC – DC buck converter using sliding mode control theory
CO5	To determine the controller expression for power factor correction circuits.

Text Books:

1. Feedback Control problems using MATLAB and the Control system tool box By Dean Frederick and Joe Chow, 2000, 1st Edition, Cengage Learning.
2. Ned Mohan,"Power Electronics: A First Course", Johnwiley, 2013, 1st Edition.
3. Marian K. Kazimierczuk and AgasthyaAyachit,"Laboratory Manual for Pulse-Width Modulated DC-DC Power Converters", Wiley 2016, 1st Edition.
4. Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press, 2002, 1st Edition.

Reference Books:

1. Sliding mode control for Switching Power Converters:, Techniques and Implementation, Slew-Chong Tan, Yuk Ming Lai Chi-Kong Tse, 1st Edition, CRC Press.
2. Andre Kislovski, "Dynamic Analysis of Switching-Mode DC/DC Converters", Springer 1991.
3. MATLAB Symbolic Algebra and Calculus Tools, Lopez Cesar, Apress, 2014.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	-	-	1	-	2	-	3	3	3	-
CO2	3	3	2	3	2	-	-	1	-	2	-	3	-	3	-
CO3	3	2	2	3	3	-	-	1	-	2	-	3	-	3	-
CO4	3	3	2	3	2	-	-	1	-	2	-	3	2	-	-
CO5	3	3	2	3	2	-	-	1	-	2	-	3	3	-	-
Avg	**3**	**2.8**	**2**	**3**	**2.4**	**-**	**-**	**1**	**-**	**2**	**-**	**3**	**2.6**	**3**	**-**

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23EEE31	EMBEDDED SYSTEM DESIGN	L	T	P	C
		2	0	2	3

Course Objectives:

- To introduce the Building Blocks of an embedded System and Software Tools
- To emphasize the role of Input/output interfacing with Bus Communication protocol.
- To illustrate the ISR and scheduling for the multitasking process.
- To explain the basics of a Real-time operating system
- To analyze the applications based on embedded design approaches

UNIT-I INTRODUCTION TO EMBEDDED SYSTEMS 6

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 6

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 6

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 6

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-V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 6

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

TOTAL : 30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Laboratory exercise: Use any Embedded processor/IDE/open source platform to give hands-on training on basic concepts of embedded system design:
a) Introduction to IDE and Programming Environment.
b) Configure timer block for signal generation (with given frequency).
c) Interrupts programming example using GPIO.
d) I2C communication with peripherals
e) Master-slave communication between processors using SPI.
2. Assignment: Introduction to VxWorks, ч C/OS-II, RT Linux
3. Embedded systems-based Mini project.

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	The hardware functionals and software strategies required to develop various Embedded systems
CO2	The basic differences between various Bus communication standards
CO3	The incorporation of the interface as Interrupt services
CO4	The various scheduling algorithms through a Real-time operating system
CO5	The various embedded concepts for developing automation applications.

TEXT BOOKS:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design, McGraw-Hill Edu, 3rd edition 2017
2. Peckol, "Embedded system Design", John Wiley & Sons,2010.

REFERENCES:

1. Shibu. K.V, "Introduction to Embedded Systems", TataMcgraw Hill, 2nd edition 2017.
2. Lya B.Das," Embedded Systems" ,Pearson Education, 1st edition 2012.
3. Parag H.Dave,Himanshu B.Dave," Embedded Systems-Concepts ,Design and Programming, Pearson Education,2015, 1st edition.
4. Elicia White, "Making Embedded systems", O' Reilly Series ,SPD,2011, 1st edition.
5. Jonathan W. Valvano, 'Embedded Microcomputer Systems Real-time Interfacing', Cengage Learning , 3rd edition 2010.
6. Tammy Noergaard, "Embedded Systems Architecture", Newnes, 2nd edition, 2013.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	-	-	3	1	1
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3
CO3	2	3	3	2	1	-	-	-	-	-	-	-	2	2	2
CO4	3	2	3	3	3	-	-	-	-	-	-	-	3	3	2
CO5	2	3	3	2	3	-	-	-	-	-	-	-	3	2	2
Avg	**2.6**	**2.8**	**3**	**2.2**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2**	**2**

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23EEE32	EMBEDDED C-PROGRAMMING	L	T	P	C
		2	0	2	3

Course Objectives:

- To expose the students to the fundamentals of embedded Programming
- To Introduce the GNU C Programming Tool Chain.
- To study the basic concepts of embedded C.
- To teach the basics of 8051 Programming
- To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT-I **BASIC C PROGRAMMING** **6**

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** **6**

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** **6**

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** **6**

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** **6**

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

TOTAL : 30 PERIODS

LAB COMPONENT: **30 PERIODS**

1. Laboratory exercise: Use 8051 microcontroller/Embedded processor/IDE/open source platform to give hands-on training on Embedded C- programming.
   a. Introduction to IDE (like code blocks, vscode ,etc)and Programming Environment (like Keililu vision, Proteus)
   b. Configuring an I/O port using bitwise programming.
   c. Configuring timer for generating hardware delay.
   d. Flashing an LED using an interrupt
   e. Serial communication using UART port of 8051
2. Assignment: Introduction to Arduino IDE, Raspberry Pi
3. Embedded C-Programming -based Mini project.

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TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES

The students will be able to:

CO1	Deliver insight into embedded C programming and its salient features for embedded systems.
CO2	Illustrate the software and hardware architecture for distributed computing in embedded systems
CO3	Develop a solution for problems by using the concept learned in programming using the embedded controllers
CO4	Develop simple applications with 8051 by using its various features and interfacing with various external hardware.
CO5	Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded programming skills.

TEXT BOOKS:

1. Paul Deitel and Harvey Deitel, "C How to Program", 9th Edition, Pearson Education Limited, 2022, 1st edition.
2. Michael J Pont, "Embedded C", Addison-Wesley, An imprint of Pearson Education, 2002.
3. William von Hagen, "The Definitive Guide to GCC", 2nd Edition, Apress Inc., 2006.
4. 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., 2015, 1st edition.
2. Steve Oualline, "Practical C programming", O'Reilly Media, 1997, 3rd edition.
3. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2nd Edition 2007.
4. Myke Predko, "Programming and customizing the 8051 microcontrollers",McGraww Hill 2000, 1st edition.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	2	3	2	2	-	-	-	-	-	-	-	3	2	3
CO3	3	2	3	2	1	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	2	2
Avg	**3**	**2.4**	**3**	**2.2**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2**	**2**

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23EEE33	EMBEDDED PROCESSORS	L	T	P	C
		2	0	2	3

Course Objectives:

- To introduce the architecture of the ARM processor.
- To train students in ARM programming.
- To discuss memory management, append location development with an ARM processor.
- To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts
- To impart the knowledge on single board embedded processors.

UNIT-I ARM ARCHITECTURE 6

Introduction to Architecture – Memory Organization – addressing modes -Registers – Pipeline - Interrupts – Coprocessors – Interrupt Structure.

UNIT-II ARM MICROCONTROLLER PROGRAMMING 6

ARM general Instruction set - Thumb instruction set -Introduction to DSP on ARM- basic programming.

UNIT-III PERIPHERALS OF ARM 6

Overview of ARM: I/O Memory - EEPROM - I/O Ports - SRAM -Timer -UART - Serial Communication with PC - ADC/DAC Interfacing-stepper motor interfacing.

UNIT-IV ARM COMMUNICATION 6

ARM With CAN, I2C, and SPI protocols.

UNIT-V INTRODUCTION TO SINGLE BOARD EMBEDDED PROCESSOR 6

Raspberry Pi Architecture - Booting Up RPi- Operating System and Linux Commands -Working with RPi using Python and Sensing Data using Python-programming - GPIO and interfacing peripherals With Raspberry Pi.

TOTAL: 30 PERIODS

LAB COMPONENTS: 30 PERIODS

1. Laboratory exercise:
a) Programming with IDE - ARM microcontroller
b) Advanced Timer Features, PWM Generator.
c) RTC interfacing with ARM using Serial communication programming, Stepper motor control.
d) ARM-Based Wireless Environmental Parameter Monitoring System displayed through Mobile device.
2. Seminar:
a) ARM and GSM/GPS interfacing
b) Introduction to ARM Cortex Processor
3. Raspberry Pi based Mini project.

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TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES

The students will be able to:

CO1	Interpret the basics and functionality of processor functional blocks.
CO2	Interpret the basics and functionality of processor functional blocks.
CO3	Incorporate the I/O hardware interface of processor with peripherals.
CO4	Emphasis the communication features of the processor.
CO5	Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors.

TEXT BOOKS:

1. Steve Furber, 'ARM system on chip architecture' ,Addisonn Wesley,2nd Edition,2015.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield' s ARM System Developer's Guide Designing and Optimizing System Software' , Elsevier 2004, 1st Edition.

REFERENCES:

1. William Hohl, ' ARMAssebly Language' Fundamentals and Techniques, CRC Press, 2nd Edition 2014.
2. Rajkamal," Microcontrollers Architecture, Programming, Interfacing, & System Design, Pearson,2012, 2nd Edition.
3. ARM Architecture Reference Manual, LPC214x User Manual www.Nuvoton .com/websites on Advanced ARM Cortex Processors
4. ARM System Developer' s Guide: Designing and Optimizing System Software 1st Edition (Designing and Optimizing System Software) Publisher: Morgan Kaufmann Publishers, 2011.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	-	-	-	3	1	1
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	2	1
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	2	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	3	1	2
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	2	2
Avg	**3**	**3**	**3**	**2.8**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1.6**	**1.4**

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23EEE34	EMBEDDED CONTROL FOR ELECTRIC DRIVES	L	T	P	C
		2	0	2	3

Course Objectives:

- To provide the control concept for electrical drives
- To emphasize the need of embedded systems for controlling the electrical drives
- To provide knowledge about various embedded system-based control strategies for
- electrical drives
- To Impart the knowledge of optimization and machine learning techniques used for
- electrical drives
- To familiarize the high-performance computing for electrical drives.

UNIT-I INTRODUCTION TO ELECTRIC DRIVES 6

Electric drives and its classification-Four-quadrant drive-Solid State Controlled Drives-Machine learning and optimization techniques for electrical drives.

UNIT-II EMBEDDED SYSTEM FOR MOTOR CONTROL 6

Embedded Processors choice for motor control- Sensors and interface modules for Electric drives-IoT for Electrical drives applications.

UNIT-III INDUCTION MOTOR CONTROL 6

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

UNIT-IV BLDC MOTOR CONTROL 6

Overview of BLDC Motor -Speed control methods -PWM techniques- Embedded processor based BDLC motor speed control.

UNIT-V SRM MOTOR CONTROL 6

Overview of SRM Motor -Speed control methods -PWM techniques- Embedded processor based SRM motor speed control.

TOTAL : 30 PERIODS

LAB COMPONENTS: 30 PERIODS

1. Laboratory exercise: Use any System level simulator/MATLAB/open source platform to give hands-on training on simulation study on Electric drives and control.
   a. Simulation of four quadrant operation and speed control of DC motor
   b. Simulation of 3-phase inverter.
   c. Simulation of Speed control of Induction motor using any suitable software package.
   d. Simulation of Speed control of BLDC motor using any suitable software package.
2. Seminar: IoT-based Control and Monitoring for DC Motor/ any Electric drives.
3. Mini project.: Any Suitable Embedded processor-based speed control of Motors (DC/IM/BLDC/PMSM/SRM)

TOTAL : 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Interpret the significance of embedded control of electrical drives
CO2	Deliver insight into various control strategies for electrical drives.
CO3	Developing knowledge of Machine learning and optimization techniques for motor control.
CO4	Develop embedded system solutions for real-time application such as Electric vehicles and UAVs.
CO5	Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded system skills required for motor control strategy.

TEXT BOOKS:

1. R.Krishnan, "Electric Motor Drives - Modeling, Analysis and Control" ,Prentice-Hall of India Pvt. Ltd., New Delhi,2010, 1st Edition.
2. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007, 1st Edition.

REFERENCES:

1. VedamSubramanyam, "Electric Drives - Concepts and Applications" , Tata McGraw- Hill publishing company Ltd., New Delhi, 2002, 2nd Edition.
2. K. Venkataratnam ,Special Electrical Machines, Universities Press, 2014, 1st Edition.
3. Steve Furber, 'ARM system on chip architecture' , Addision Wesley, 2nd Edition 2015.
4. Ron Sass and AnderewG.Schmidt, " Embedded System design with platform FPGAs:Principles and Practices" , Elsevier, 2010, 1st Edition.
5. Tim Wescott , Applied Control Theory for Embedded Systems , Elsevier, 2006, 1st Edition.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-	-	-	-	-	-	3	1	1
CO2	3	2	2	2	3	-	-	-	-	-	-	-	2	2	1
CO3	3	3	2	2	3	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	1	1
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	1	2
Avg	**3**	**2.6**	**2**	**2.2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1.4**	**1.4**

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23EEE35	IOT CONCEPTS AND APPLICATIONS	L	T	P	C
		2	0	2	3

Course Objectives:

- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things(IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
- To apply the concept of Internet of Things in real world scenario.

UNIT-I INTRODUCTION TO INTERNET OF THINGS 5

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT

UNIT-II COMPONENTS IN INTERNET OF THINGS 5

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)

UNIT-III PROTOCOLS AND TECHNOLOGIES BEHIND IOT 6

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT-IV OPEN PLATFORMS AND PROGRAMMING 7

IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT-V IOT APPLICATIONS 7

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

TOTAL: 30 PERIODS

LAB COMPONENTS: 30 PERIODS

1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module

5 Introduction to Raspberry PI platform and python programming

6. Interfacing sensors to Raspberry PI

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1 Explain the concept of IoT.

CO2 Understand the communication models and various protocols for IoT.

CO3 Design portable IoT using Arduino/Raspberry Pi /open platform

CO4 Apply data analytics and use cloud offerings related to IoT.

CO5 Analyze applications of IoT in real time scenario.

TEXT BOOKS:

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCES:

1. Marc F madou" Fundamentals of micro fabrication" CRC Press 2002 2nd Edition Marc Madou. Perry Lea, "Internet of things for architects", Packt, 2018.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	-	-	-	3	2	1
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	2	1
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	2	1
CO4	3	3	3	2	3	-	-	-	-	-	-	-	3	2	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	1	2
Avg	3	3	3	2.8	3	-	-	-	-	-	-	-	3	1.8	1.4

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23EEE36	EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS	L	T	P	C
		2	0	2	3

Course Objectives:

- To expose the students to the fundamentals and building of Electronic Engine Control systems.
- To teach on sensor functional components for vehicles.
- To discuss on programmable controllers for vehicles management systems.
- To teach logics of automation & communication techniques for vehicle communication.
- To introduce the infotainment system development
- To analyze the applications based on embedded design approaches

UNIT-I INTRODUCTION TO AUTOMOTIVE SYSTEMS 6

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 6

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

UNIT-III VEHICLE MANAGEMENT SYSTEMS 6

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

UNIT-IV ONBOARD DIAGONSTICS AND COMMUNICATION 6

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

UNIT-V RECENT TRENDS 6

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

TOTAL : 30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Laboratory exercise: Use MATLAB SIMULINK /equivalent simulation /open source tools
   a) Simulation study of automotive sensors and actuators components
   b) Adaptive cruise control, Anti-Lock Braking System
   c) CAN Connectivity in an Automotive Application using vehicle network toolbox
   d) Interfacing a sensor used in car with microcontroller.
   e) Establishing connection between Bluetooth module and microcontroller.
2. Assignment: AUTOSAR
3. Mini project : Battery Management system for EV batteries.

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Insight into the significance of the role of embedded system for automotive applications.
CO2	Illustrate the need, selection of sensors and actuators and interfacing with ECU
CO3	Develop the Embedded concepts for vehicle management and control systems.
CO4	Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs
CO5	Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.

TEXT BOOKS:

1. William B. Ribbens ,"Understanding Automotive Electronics", Elseiver,8th Edition, 2017.
2. Jurgen, R., Automotive Electronics Hand Book, McGraw Hill, 2nd Edition, 1999.
3. L.Vlacic,M.Parent,F.Harahima,"Intelligent Vehicle Technologies",SAE International, 2001, 1st Edition, 2017.

REFERENCES:

1. Ali Emedi, Mehrdedehsani, John M Miller , "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004, 1st Edition.
2. Jack Erjavec,JeffArias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage ,2012, 2nd Edition.
3. Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford 2nd Edition, 2004.
4. Automotive Electricals / Electronics System and Components, Tom Denton, 5th Edition, 2017.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	-	-	3	1	1
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3
CO3	3	2	3	2	1	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO5	3	2	3	2	3	-	-	-	-	-	-	-	3	2	2
Avg	3	2.6	3	2.2	2.2	-	-	-	-	-	-	-	2.8	2	2

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23EEE37	VLSI DESIGN	L	T	P	C
		2	0	2	3

Course Objectives:

- To explain the basic concepts of CMOS and
- To introduce the IC fabrication methods
- To introduce the Reconfigurable Processor technologies
- To introduce the basics of analog VLSI design and its importance.
- To learn about the programming of Programmable device using Hardware description Language.

UNIT-I **CMOS BASICS** **6**

MOSFET Scaling - CMOS logic design- Dynamic CMOS –Transmission Gates- BiCMOS

UNIT-II **IC FABRICATION** **6**

CMOS IC Fabrications: n well, p well, twin tub, SoI - Design Rules and Layout.

UNIT-III **PROGRAMABLE LOGIC DEVICES** **6**

PAL, PLA, CPLD architecture and application.

UNIT-IV **RECONFIGURABLE PROCESSOR** **6**

FPGA- Architecture, FPGA based application development- Introduction to FPAA.

UNIT-V **HDL PROGRAMMING** **6**

Verilog HDL- Overview - structural and behavioural modeling concepts-Design examples- Carry Look ahead adders, ALU, Shift Registers.

TOTAL : 30 PERIODS

LAB COMPONENT: **30 PERIODS**

1. Laboratory exercise : Use any FPGA Board /IDE/open source package/ platform to give hands on training on CMOS design/ reconfigurable processor based applications.

a) CMOS logic circuit simulation using any open source software package

b) Experiments : structural and behavioural modeling based Verilog HDL programs

c) Experiment: Combinational and sequential Digital logic implementation with FPGA.

d) Implementation of carry look ahead adder with FPGA

e) Implementation of ALU with FPGA

2. Assignment : Low Power VLSI.

3. FPGA based Mini project

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Develop CMOS design techniques
CO2	Learn and build IC fabrication
CO3	Explain the need of reconfigurable computing with PLDs.
CO4	Design and development of reprogrammable FPGA.
CO5	Illustrate and develop HDL computational processes with improved design strategies.

TEXT BOOKS:

1. M.J.S Smith, "Application Specific integrated circuits", Addition Wesley Longman Inc. 1st Edition 2010.
2. Kamran Eshraghian, Douglas A.pucknell and Sholeh Eshraghian, "Essentials of VLSI circuits and system", Prentice Hall India,2005, 1st Edition.

REFERENCES:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002, 1st Edition.
2. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 7th Edition 2013.
3. Nurmi, Jari (Ed.) , "Processor Design System-On-Chip Computing for ASICs and FPGAs" Springer, 2007, 1st Edition.
4. Joao Cardoso, Michael Hubner, "Reconfigurable Computing: From FPGAs to Hardware/Software Codesign", Springer, 2011, 1st Edition.
5. Pierre-Emmanuel Gaillardon, "Reconfigurable Logic: Architecture, Tools, and Applications", 1st Edition, CRC Press, 2018.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	-	-	-	3	1	1
CO2	3	3	2	2	3	-	-	-	-	-	-	-	3	2	3
CO3	3	3	2	2	3	-	-	-	-	-	-	-	3	2	2
CO4	3	2	2	3	3	-	-	-	-	-	-	-	2	2	2
CO5	3	3	2	2	3	-	-	-	-	-	-	-	3	2	2
Avg	**3**	**2.8**	**2**	**2.2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.8**	**1.8**	**2**

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23EEE38	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS	L	T	P	C
		2	0	2	3

Course Objectives:

- Understand the importance, principles, and search methods of AI.
- Provide knowledge on predicate logic and Prolog.
- Introduce machine learning fundamentals.
- Study of supervised learning algorithms.
- Study about unsupervised learning algorithms.

UNIT-I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or uniform-cost search –

UNIT-II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6

Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

UNIT-III LEARNING 6

Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance -

UNIT-IV SUPERVISED LEARNING 6

Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - Decision Tree: Entropy – Information gain - Gini Impurity - classification algorithm - Rule based Classification - Naïve Bayesian classification - Support Vector Machines (SVM)

UNIT-V UNSUPERVISED LEARNING 6

Unsupervised Learning – Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm

TOTAL: 30 PERIODS

LAB COMPONENT: 30 PERIODS

Programs for Problem solving with Search

1. Implement breadth first search
2. Implement depth first search
3. Analysis of breadth first and depth first search in terms of time and space

Supervised learning.

4. Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
5. Write a program to demonstrate the working of the decision tree based algorithm.

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6. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.

Unsupervised learning

7. Implementing neural network using self-organizing maps 230
8. Implementing k-Means algorithm to cluster a set of data.
9. Implementing hierarchical clustering algorithm.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES

The students will be able to:

CO1 Understand the foundations of AI and the structure of Intelligent Agents.

CO2 Use appropriate search algorithms for any AI problem.

CO3 Study of learning methods.

CO4 Solving problem using Supervised learning.

CO5 Solving problem using Unsupervised learning.

TEXT BOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth Edition, 2021
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed,

REFERENCES:

1. Thomas Bräunl, Embedded Robotics, Springer, 2003. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. I. Bratko, "Prolog: Programming for Artificial Intelligence||, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	-	3	1	1
CO2	3	1	3	2	3	-	-	-	-	-	-	-	3	2	3
CO3	3	3	2	2	3	-	-	-	-	-	-	-	3	2	2
CO4	3	3	2	3	3	-	-	-	-	-	-	-	3	3	2
CO5	3	3	2	2	3	-	-	-	-	-	-	-	3	2	2
Avg	3	2.6	2.4	2.2	3	-	-	-	-	-	-	-	3	2	2

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23EEE39	DIGITAL SIGNAL PROCESSING SYSTEM DESIGN	L	T	P	C
		2	0	2	3

Course Objectives:

- To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain through mathematical representation.
- To study the various time to frequency domain transformation techniques.
- To understand the computation algorithmic steps for Fourier Transform.
- To study about filters and their design for digital implementation.
- To introduce the programmable digital signal processor & its application.

UNIT-I **DISCRETE-TIME SIGNALS AND SYSTEMS** **6**

Need and benefits of Digital Signal Processing - Sampling and Quantization of analog signals - Signal classification and basic operations - LTI system –Impulse response - - Determination of Impulse response and Step response using Z transformation - A Typical DSP system

UNIT-II **DISCRETE TRANSFORMS** **6**

Fourier Series and Fourier Transform - Discrete Fourier Transform (DFT) - Properties- DFT frequency axis - DIT - FFT and DIF - FFT radix2 algorithms- linear filtering via circular convolution-inverse FFT.

UNIT-III **DESIGN OF IIR DIGITAL FILTERS** **6**

Characteristics and applications of IIR filters - Design techniques for analog filters - Frequency transformation - Digital IIR filter design: impulse invariant and bilinear transform methods - Canonical forms of Realization: direct, cascade, and parallel forms

UNIT-IV **DIGITAL SIGNAL PROCESSORS** **6**

Introduction - Architecture of one DSP processor for motor control - Features - Addressing Formats- Functional modes - Introduction to Commercial Processors

UNIT-V **REALTIME DIGITAL SIGNAL PROCESSING** **6**

Real Time DSP System Architecture and Functional Blocks, Analog Interface, Signal Conditioning, generation and detection for real time applications, - DSP Hardwares (Digital Signal Processor, FPGA, ARM Processor with DSP Extension) & its applications

TOTAL : 30 PERIODS

LAB COMPONENTS: **30 PERIODS**

1. Laboratory exercise : Use any DSP processor/MATLAB/open source platform to give hands on training on basic concepts of Digital Signal Processing
   a) To determine impulse and step response of two vectors
   b) To perform convolution between two vectors .
   c) To compute DFT and IDFT of a given sequence.
   d) To perform linear convolution of two sequence using DFT
   e) Design and Implementation of FIR Filter
   f) Design and Implementation of IIR Filter
2. Assignment : Implementation of FIR/IIR filter with FPGA.
3. DSP processors based Mini project.

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TOTAL : 30+30 = 60 PERIODS

COURSE OUTCOMES

The students will be able to:

CO1 Explain the concepts of digital signal processing

CO2 Illustrate the system representation using transforms

CO3 Design suitable digital FIR, IIR algorithm for the given specification

CO4 Use digital signal processor for application development

CO5 Apply the signal processing technique in speech signal and image processing

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 4th Edition 2007.
2. Robert J.Schilling & Sandra L.Harris ,' Introduction to Digital Signal Processing using MATLAB', Cengage Learning, 2nd Edition 2013.

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1. Emmanuel C Ifeachor and Barrie W Jervis, "Digital Signal Processing - A Practical approach", Pearson Education, Second edition, 2002.
2. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, "Discrete - Time Signal Processing", Pearson Education, New Delhi, 2nd Edition 2012.
3. SenM.kuo, Woonsens.gan, "Digital Signal Processors, Architecture, Implementations & Applications", Pearson, 1st Edition 2004.
4. S.K. Mitra, "Digital Signal Processing - A Computer Based Approach", Tata McGraw Hill, New Delhi, 4th Edition 2013.
5. B. Venkataramani, M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw Hill, New Delhi, 2003, 1st Edition.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	-	-	-	3	2	1
CO2	3	3	2	2	3	-	-	-	-	-	-	-	3	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	2	2
CO4	3	2	3	2	3	-	-	-	-	-	-	-	3	3	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	3	2
Avg	**3**	**2.8**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2.4**	**1.8**

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23EEE41	ELECTRICVEHICLE ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn the structure of Electric Vehicle, Hybrid Electric Vehicle
- To study about the EV conversion components
- To know about the details and specifications for Electric Vehicles
- To understand the concepts of Plug-in Hybrid Electric Vehicle
- To model and simulate all types of DC motors

UNIT-I VEHICLE MECHANICS 7+2

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire -Road mechanics, Propulsion System Design.

UNIT-II VEHICLE ARCHITECTURE and SIZING 7+2

Electric Vehicle History and Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Micro and Mild architectures. Mountain Bike - Motorcycle- Electric Cars and Heavy Duty EVs. -Details and Specifications

UNIT-III POWER COMPONENTS AND BRAKES 7+2

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing, Example.

UNIT-IV HYBRID VEHICLE CONTROL STRATEGY 7+2

Vehicle supervisory controller, Mode selection strategy, Modal Control strategies.

UNIT-V PLUG-IN HYBRID ELECTRIC VEHICLE 7+2

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / etc) Basics of MATLAB simulation 10

1. Variables and Expressions Formats, Vectors and Matrices,
2. Arrays, Vectors,
3. Matrices, Built-in functions, Trigonometric functions,
4. Data types and Plotting.
5. Simulation of drive cycles.

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COURSE OUTCOMES

The students will be able to:

CO1 Summarize the History and Evolution of EVs, Hybrid and Plug-In Hybrid EVs

CO2 Describe the various EV components

CO3 Describe the concepts related in the Plug-In Hybrid Electric Vehicles

CO4 Analyse the details and Specifications for the various EVs developed.

CO5 Describe the hybrid vehicle control strategy

Text Books:

1. Dr.S.V. Dishor , "Electric Vehicle Architecture" Lakshmi Publications,Chennai, 2021.
2. S. Nazrin Salma, S. Arumuga Kani and A. Niyas Ahamed, "Electric Vehicle Architecture", AkiNik Publications, 2023.

Reference Books:

1. Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
2. Build Your Own Electric Vehicle,Seth Leitman , Bob Brant, McGraw Hill, Third Edition 2013.
3. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.
4. The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles -- Includes EV Components, Kits, and Project Vehicles Mark Warner, HP Books,2011.
5. Heavy-duty Electric Vehicles from Concept to Reality, Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, Elsevier Science, 2021

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO2	3	-	2	-	-	-	-	1	-	-	-	2	3	3	3
CO3	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO4	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO5	3	-	3	3	3	-	-	1	-	-	-	2	3	3	3
Avg	**3**	**-**	**2.2**	**3**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**3**	**3**

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BoS / EEE

23EEE42	DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

Course Objectives:

- To review the drive cycles and requirements of EVs
- To know the working of motors used in Electric Vehicle
- To analyze and model the buck/boost converter operation and to design the same
- To learn the simulation basics of control systems
- To derive transfer functions for DC-DC converters

UNIT-I ELECTRIC VEHICLE DYNAMICS 6

Standard drive cycles-Dynamics of Electric Vehicles-Tractive force-Maximum speed, torque, power, energy requirements of EVs.

UNIT-II MOTORS FOR ELECTRIC VEHICLES 6

Introduction – Speed And Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs.

UNIT-III BASICS OF SIMULATION IN CONTROL SYSTEMS 6

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.

UNIT-IV MODELING OF DC-DC CONVERTERS 6

Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling – Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics - Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage - Frequency Response of Converter

UNIT-V POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS 6

Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function, Load Current-to-Output Transfer Function.

Total : 30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Simple simulation exercises of basic control systems
2. Bode plots and calculation of Gain margin and Phase margin for power stage transfer function via simulation.
3. Design of buck converter
4. Design of boost converter
5. Simulation of buck, boost and buck boost converter-open loop (With power circuit and Transfer function).

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	To use appropriate electric machine for electric vehicle application
CO2	To compute transfer function with factors such as constant, integral, differential, first order factor and second order factor (both numerators & denominators)
CO3	To compute transfer function from state models
CO4	To design buck, boost and buck-boost converter.
CO5	To compute a power stage transfer functions for DC-DC converters
CO6	To simulate DC-DC converters and to obtain gain margin and phase margin.

Text Books:

1. Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design, and Control, Md. Rabiul Islam,Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press,2021, 1st Edition.
2. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2nd Edition, 2013, Lakshmi publications
3. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005,1st Edition.

Reference Books:

1. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.
2. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley,2021, 1st Edition.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	-	-	1	-	3	-	3	3	-	1
CO2	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO3	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO5	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO6	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
Avg	3	3	3	3	3	-	-	1	-	3	-	3	3	3	2.6

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BoS / EEE

23EEE43	ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn the basics of EV and vehicle mechanics
- To know the EV architecture
- To study the energy storage system concepts
- To derive model for batteries and to know the different types of batteries and its charging methods
- To learn the control preliminaries for DC-DC converters.

UNIT-I INTERNAL COMBUSTION ENGINES 6

IC Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control Systems, Treatment of Diesel Exhaust Emissions

UNIT-II ELECTRIC VEHICLES AND VEHICLE MECHANICS 6

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT-III BATTERY MODELING, TYPES AND CHARGING 6

Batteries in Electric and Hybrid Vehicles - Battery Basics -Battery Parameters. Types of batteries, Research and Development for Advanced Batteries. Battery Modelling, Electric Circuit Models. Battery Pack Management, Battery Charging.

UNIT-IV CONTROL PRELIMINARIES 6

Control Design Preliminaries - Introduction - Transfer Functions – Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode

UNIT-V CONTROL OF AC MACHINES 6

Introduction- Reference frame theory, basics-modeling of induction and synchronous machine in various frames-Vector control- Direct torque control.

TOTAL : 30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Develop a model that could estimate Soc and SoH of Li-Ion Battery.
2. Modelling and thermal analysis of Li-Ion Battery.
3. Simulation of boost converter and calculating gain and phase margin from the transfer function.
4. Simulation of vector control of induction motor

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	To describe the concepts related with EV, HEV and to compare the same with internal combustion engine vehicles
CO2	To find gain margin & phase margin for various types of transfer functions of boost converter
CO3	To demonstrate the Control of A C Machines
CO4	To explain the concepts related with batteries and parameters of battery
CO5	To module the battery and to study the research and development for batteries

Text Books:

1. Iqbal Husain, "Electric and Hybrid Vehicles, Design Fundamentals", Third Edition, CRC Press, 2021
2. Wie Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, John Wiley & Sons, 2017, 2nd Edition.
3. Power Electronic Converters, "Dynamics and Control in Conventional and Renewable Energy Applications", Teuvo Suntio, Tuomas Messo, Joonas Puukko, 1st Edition, Wiley - VCH

Reference Books:

1. Ali Emadi, Mehrdad Ehsani, John M.Miller, "Vehicular Electric Power Systems", Special Indian Edition, Marcel dekker, Inc 2003, 1st Edition.
2. C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press, 2001, 1st Edition.
3. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/ SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley, 2021, 1st Edition.
4. Dynamic Simulation of Electric Machinery using MATLAB, Chee Mun Ong, Prentice Hall,1997, 1st Edition

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3								1	2		2	3		3
CO2	3								1	3		2	3		3
CO3	3						3		1	2		2	3		3
CO4	3						3		1	2		2	3		3
CO5	3						3		1	2		2	3	2	3
Avg	3						3		1	2.3		2	3	2	3

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23EEE44	DESIGN OF ELECTRIC VEHICLE CHARGING SYSTEM	L	T	P	C
		2	0	2	3

Course Objectives:

- To know the charging station and standards
- To learn the concepts of power converters in charging
- To find the charging scheme in renewable based EV charging
- To demonstrate the wireless power transfer technique
- To design & simulate power factor correction circuits

UNIT-I CHARGING STATIONS AND STANDARDS 6

Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations - Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations

UNIT-II POWER ELECTRONICS FOR EV CHARGING 6

Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC–DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC–DC Converters- Non-isolated DC–DC bidirectional converter topologies- Half-bridge bidirectional converter.

UNIT-III EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS 6

Introduction- - EV charger topologies , EV charging/discharging strategies - Integration of EV charging-home solar PV system , Operation modes of EVC-HSP system , Control strategy of EVCHSP system - fast-charging infrastructure with solar PV and energy storage.

UNIT-IV WIRELESS POWER TRANSFER 6

Introduction - Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles - Types of Electric Vehicles - Battery Technology in EVs -Charging Modes in EVs - Benefits of WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO 19363

UNIT-V POWER FACTOR CORRECTION IN CHARGING SYSTEM 6

Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses

TOTAL: 30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Simulation and analysis for bi-directional charging V2G and G2V.
2. Design and demonstrate solar PV based EV charging station.
3. Simulate and infer wireless power charging station for EV charging.
4. Simulation of boost converter based power factor correction.

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	To illustrate various charging techniques and to know charging standards and regulations.
CO2	To demonstrate the working o DC-DC converters used for charging systems and principles
CO3	To illustrate the advantages of renewable system based charging systems
CO4	To demonstrate the principles of wireless power transfer.
CO5	To analyze the standards for wireless charging
CO6	To design and simulate boost converter based power factor correction

Text Books:

1. Mobile Electric Vehicles Online Charging and Discharging, Miao Wang Ran Zhang Xuemin (Sherman) Shen, Springer 2016, 1st Edition.
2. Alicia Triviño-Cabrera, José M. González-González, José A. Aguado, Wireless Power Transferor Electric Vehicles: Foundations and Design Approach, Springer Publisher 1st Edition. 2020.

Reference Books:

1. Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, Electric Vehicles Modern Technologies and Trends. Springer Publisher 1st Edition, 2021.
2. Cable Based and Wireless Charging Systems for Electric Vehicles, Technology and control, management and grid integration, Rajiv Singh, Sanjeevikumar Padmanaban, Sanjeet Dwivedi, Marta Molinas and Frede Blaabjerg, IET 2021, 1st Edition
3. Electric and Hybrid Electric Vehicles, James D Halderman, Pearson, 2022, 1st Edition.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3			2	2		3		3	3		
CO2	3	3	3	3			2	2		3		3	3	3	3
CO3	3												3	3	3
CO4	3	3	3	3			2	2		2		1	3	3	3
CO5	3												3	3	3
CO6	3	3	3	3	3		2	2		3		2	3	3	3
Avg	**3**	**3**	**3**	**3**	**3**		**2**	**2**		**2.75**		**2.25**	**3**	**3**	**3**

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23EEE45	TESTING OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

Course Objectives:

- To know various standardization procedures
- To learn the testing procedures for EV & HEV components
- To know the functional safety and EMC
- To realize the effect of EMC in EVs
- To study the effect of EMI in motor drives and in DC-DC converter system

UNIT-I EV STANDARDIZATION 6

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

UNIT-II TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES 6

Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.

UNIT-III FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC 6

Functional safety life cycle - Fault tree analysis - Hazard and risk assessment - re development - Process models - Development assessments - Configuration management - Reliability - Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality - Standards - Functional safety of autonomous vehicles.

UNIT-IV EMC IN ELECTRIC VEHICLES 6

Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements

UNIT-V EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM 6

Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path

TOTAL: 30 PERIODS

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LAB COMPONENT: **30 PERIODS**

1. Design and simulate motor controller for hybrid electric vehicle applications
2. Simulation of EMC analysis for Wireless power transfer EV charging.
3. Design and simulation of EMI filter

Total : 30+30 = 60 PERIODS

COURSE OUTCOMES

The students will be able to:

CO1 To describe the status and other details of standardization of EVs

CO2 To illustrate the testing protocols for EVs and HEV components

CO3 To analyze the safety cycle and need for functions safety for EVs

CO4 To analyze the problems related with EMC for EV components.

CO5 To evaluate the EMI in motor drive and DC-DC converter system.

Text Books:

1. Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative, Beate Müller, Gereon Meyer, Springer 2015, 1st Edition.
2. EMI/EMC Computational Modeling Handbook, Druce Archam beault, colin branch, Omar M.Ramachi ,Springer 2012, 2nd Edition.

Reference Books:

1. EMC and Functional Safety of Automotive Electronics, Kai Borgeest, IET 2018, 1st Edition.
2. Electromagnetic Compatibility of Electric Vehicle, Li Zhai, Springer 2021, 1st Edition.
3. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005, 1st Edition.
4. Automotive EMC, Mark Steffika, Springer 2013, 1st Edition.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1				2						3		2
CO2	3	1	1				1						3		2
CO3	3	1	1				2						3		2
CO4	3	1	1				1						3		2
CO5	3	1	1				2						3		3
Avg	**3**	**1**	**1**				**1.8**						**3**		**2.3**

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23EEE46	GRID INTEGRATION OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives:

- To know the basic details of V2G
- To study the benefits & challenges of V2G
- To learn EV & V2G on the smart grids renewable energy systems
- To know the grid integration

UNIT-I **DEFINITION, And STATUS Of V2G** **7+2**

Defining V2G - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering , V2G in Practice , V2G, Power Markets and Applications . Electricity Markets and V2G Suitability , Long-Term Storage, Renewable Energy, and Other Grid Applications , Beyond the Grid: Other Concepts Related to V2G.

UNIT-II **BENEFITS AND CHALLENGES OF V2G** **7+2**

Benefits of V2G, Technical Benefits: Storage Superiority and Grid Efficiency, Economic Benefits: EV Owners and Societal Savings, Environment and Health Benefits: Sustainability in Electricity and Transport, Other Benefits.

UNIT-III **CHALLENGES TO V2G** **7+2**

Technical Challenges-Battery Degradation, Charger Efficiency, Aggregation and Communication, V2G in a Digital Society. The Economic and Business Challenges to V2G - Evaluating V2G COsts and Revenues , EV COsts and Benefits , Adding V2G COsts and Benefits , Additional V2G COsts , The Evolving Nature of V2G COsts and Benefits. Regulatory and Political Challenges to V2G , V2G and Regulatory Frameworks , Market Design Challenges. Other V2G Regulatory and Legal Challenges.

UNIT-IV **IMPACT OF EV AND V2G ON THE SMART GRID AND RENEWABLE ENERGY SYSTEMS** **7+2**

Introduction - Types of Electric Vehicles - Motor Vehicle Ownership and EV Migration - Impact of Estimated EVs on Electrical Network - Impact on Drivers and the Smart Grid - Standardization and Plug-and-Play - IEC 61850 Communication Standard and IEC 61850-7-420 Extension.

UNIT-V **GRID INTEGRATION AND MANAGEMENT OF EVS** **7+2**

Introduction-M2M in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles - M2M communication with scheduling.

TOTAL: 45 PERIODS

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SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / etc) **10**

1. Simulation of connecting three phase inverter to the grid.
2. Simulate and analyse the power quality issues of V2G systems
3. Design and simulate battery management system for smart grid with distributed generation.

COURSE OUTCOMES

The students will be able to:

CO1	Explain the concepts related with V2G
CO2	Study the grid connection of 3 phase Q inverter
CO3	Explain the technical, economics. business, regulatory & political challenges related with V2G
CO4	Demonstrate the impact of EV and V2G on smart grid and renewable energy system
CO5	Explain the concept of grid integration and management of EVs

Text Books:

1. Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid, Junwei Lu and Jahangir Hossain, IET 2015, 1st Edition.
2. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press 2017, 1st Edition.

Reference Books:

1. Plug In Electric Vehicles in Smart Grids, Charging Strategies, Sumedha Rajakaruna , Farhad Shahnia and Arindam Ghosh,Springer,2015, 1st Edition
2. ICT for Electric Vehicle Integration with the Smart Grid, Nand Kishor , Jesus Fraile-Ardanuy, IET 2020, 1st Edition
3. Lance Noel · Gerardo Zarazua de Rubens Johannes Kester · Benjamin K. Sovacool, Vehicleto-Grid A Sociotechnical Transition Beyond Electric Mobility, 2019, 1st Edition.

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						2	1		2			3	3	1
CO2	3	3			3		2	1		2			3		
CO3	3						2	1		2			3		
CO4	3						2	1		2			3		2
CO5	3						2	1		2			3		3
Avg	**3**	**3**			**3**		**2**	**1**		**2**			**3**	**3**	**1.2**

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BoS / EEE

23EEE47	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

Course Objectives:

- To design and drive the mathematical model of a BLDC motor and its characteristics
- To learn the different control schemes for BLDC motor
- To study the basics of fuzzy logic
- To study the FPGA & VHDL basics
- To implement fuzzy logic control of BLDC motor in real time

UNIT-I MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR 6

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients.

UNIT-II SPEED CONTROL FOR ELECTRIC DRIVES 6

Introduction -PID Control Principle, Ant windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor

UNIT-III FUZZY LOGIC 6

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures - fuzzy rule base and approximate reasoning.

UNIT-IV FPGA AND VHDL BASICS 6

Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA.

UNIT-V REAL TIME IMPLEMENTATION 6

Introduction-M2M in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles - M2M communication with scheduling.

TOTAL: 30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Design and simulate speed controller for induction motors in EV for both dynamic and steady state performance
2. Simulate a fuzzy logic controller based energy storage system for EV.
3. Fuzzy logic control of BLDC motor using FPGA in real time

TOTAL: 30+30 = 60 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	To design the mathematical model of a BLDC motor and to discuss about its characteristics
CO2	To demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. Control applied to BLDC motor.
CO3	To illustrate the basics of fuzzy logic system
CO4	To describe the basics of VHDL & FPGA applied to control of EVs.
CO5	To design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time

Text Books:

1. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley 2012, 1 st Edition.
2. M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1 st Edition, 2002.

Reference Books:

1. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1st Edition 2018.
2. Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele Crisostomi , Robert Shorten, Sonja Stüdli, Fabian Wirth, CRC Press, 1st Edition. 2018
3. VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1 st Edition 2015.
4. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRC Press, Taylor & Francis Group, 2021, 1 st Edition.
5. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley 2017, 2nd Edition

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2				3		2		3	3	3	
CO2	3	3	2	2				3		2		3	3	3	3
CO3	3	3	3	3						2		3	3	2	3
CO4	3	3	3	3						2		3	3	3	3
CO5	3	3	3	3	3			3		2		3	3	3	3
Avg	**3**	**3**	**2.6**	**2.6**	**3**			**3**		**2**		**3**	**3**	**2.8**	**2.4**

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23EEE51	PROCESS MODELING AND SIMULATION	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the important of mathematical models for Industrial processes
- To acquaint students with different forms of mathematical models.
- To develop and simulate mathematical models for different Industrial processes.
- To apply Mathematical tools while developing mathematical models.
- To analyze the graphical response of developed mathematical models.

UNIT-I GENERAL PRINCIPLES OF MODELLING (7+2 SKILL)

Introduction to mathematical modeling; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes; Classification of models: Linear vs Nonlinear, Lumped parameter vs. Distributed parameter; Static vs. Dynamic, Continuous vs. Discrete; Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODEBVP.

UNIT-II MODELLING OF DISTRIBUTED PROCESSES (7+2 SKILL)

Steady state models giving rise to differential algebraic equation (DAE) systems; Rate based Approaches for staged processes; Modeling of differential contactors – distributed parameter models of packed beds; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs), Partial Differential Equations (PDEs), and available numerical software libraries.

UNIT-III INTRODUCTION TO PROCESS MODELLING (7+2 SKILL)

Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of freedomin a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection, Persistent Recycle.

UNIT-IV MODELLING OF INDUSTRIAL PROCESSES (7+2 SKILL)

Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, -steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical software libraries.

UNIT-V SIMULATION OF MATHEMATICAL MODELLING (7+2 SKILL)

Simulation and their approaches, Modular, Sequential, Simultaneous and Equation solving approach, Simulation softwares and their applications, Review of solution techniques and available numerical software libraries.- Case Studies.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES :

(Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Developing steady state /Dynamic mathematical model of different unit processes (ODE or PDE)
2. Simulation of steady state/ dynamic models using appropriate software
3. Open loop study based on the developed mathematical model.
4. Development and simulation of unsteady state models for simple processes.

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COURSE OUTCOMES:

The students will be able to:

CO1	Will be able to understand different methods of developing models for industrial processes.
CO2	Able to build mathematical models by applying relevant mathematics.
CO3	Able to implement mathematical models using relevant software.
CO4	Effectively perform analysis and subsequent conclusion for the developed mathematical models.
CO5	Able to interpret the results obtained from the mathematical model in terms of original real world problem

TEXT BOOKS:

1. Denn M. M.,"Process Modeling", Longman, 1986, 1st Edition.
2. Aris R.,"Mathematical Modeling,A Chemical Engineering Perspective (Process System Engineering)", Academic Press, 1999, Volume 1 .

REFERENCES:

1. Luyben W.L., "Process Modeling, Simulation, and Control for Chemical Engineering", McGraw Hill, 2nd Edition, 1990.
2. D. F. Rudd and C. C. Watson, " Strategy of Process Engineering", Wiley international, 1st Edition, 1968.
3. M.M. Denn, "Process Modelling", Wiley, New York, 1st Edition, 1986.
4. A. K. Jana, "Chemical Process Modelling and Computer Simulation", PHI,1st Edition, 2011.

List of Open Source Software/ Learning website:

1. https://archive.nptel.ac.in/courses/103/107/103107096/
2. https://nptel.ac.in/courses/103101111
3. https://nptel.ac.in/courses/111107105

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	2	1	-	1	1	1	1	1	1	2	2
CO2	3	1	2	-	-	1	-	1	1	1	1	1	1	2	2
CO3	1	-	2	3	-	1	-	1	1	1	1	1	1	2	2
CO4	1	-	3	-	-	1	2	1	1	1	1	1	1	2	2
CO5	1	2	-	3	-	1	-	1	1	1	1	1	1	2	2
Avg	**3**	**1**	**1.4**	**1.5**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

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23EEE52	COMPUTER CONTROL OF PROCESSES	L	T	P	C
		3	0	0	3

Course Objectives:

- To represent the linear time invariant System in discrete State Space form
- To analyze the controllability, observability and stability of a Discrete time System.
- To estimate model parameters from input/output measurements
- To Design Digital Controllers
- To Design Multi-loop and Multivariable Controllers for multivariable system.

UNIT-I DISCRETE STATE-VARIABLE TECHNIQUE (7+2 SKILL)

State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data system–Stability tests of discrete-data system.

UNIT-II SYSTEM IDENTIFICATION (7+2 SKILL)

Identification of Non Parametric Input-Output Models:-Transient analysis–Frequency analysis Correlation analysis– Spectral analysis – Identification of Parametric Input- Output Models:- Least Squares Method – Recursive Least Square Method.

UNIT-III DIGITAL CONTROLLER DESIGN (7+2 SKILL)

Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller– Dead-beat controller and Dahlin's controller – IMC - Smith Predictor.

UNIT-IV MULTI-LOOP REGULATORY CONTROL (7+2 SKILL)

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs –The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.

UNIT-V MULTIVARIABLE REGULATORY CONTROL (7+2 SKILL)

Introduction to Multivariable control –Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Fuzzy Logic Controller – Case Studies: - Distillation Column, CSTR and Four-tank system.

TOTAL :45PERIODS

SKILL DEVELOPMENT ACTIVITIES :

(Group Seminar/Mini Project/ Assignment/ Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)

1. Calculate the RGA to determine the recommended pairing between controlled and manipulated variables for any system.
2. Seminar on LS, RLS methods.
3. Design of DMC for distillation Column, CSTR and Four-tank system in MATLAB.
4. Design a Multi-loop & Multivariable controller for MIMO system.
5. Design a model for any industrial process using parametric & non-parametric system.

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COURSE OUTCOMES:

The students will be able to:

CO1	Develop mathematical models for discrete time systems using state variable techniques and analyze the stability of the systems.
CO2	Construct models from input-output data by least square and recursive least square method.
CO3	Ability to design different digital controllers to satisfy the required criterion
CO4	Design a multi-loop controller and multivariable controller for multi-variable systems.
CO5	Ability to design multivariable dynamic matrix controller for industrial processes.

TEXT BOOKS:

1. Stephanopoulos, G., "Chemical Process Control -An Introduction to Theory and Practice", Prentice Hall of India, 1st Edition, 2015.
2. Sigurd Skogestad, Ian Postlethwaite, "Multivariable Feedback Control: Analysis and Design", John Wiley and Sons, 2005, 2nd Edition.

REFERENCES:

1. Thomas E. Marlin, Process Control – Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill,2000, 2nd Edition.
2. Gopal, M., "Digital Control and State Variable Methods", Tata Mc Graw Hill, 4th Edition, 2017.
3. P. Albertos and A. Sala, "Multivariable Control Systems An Engineering Approach", Springer Verlag, 1st Edition, 2004
4. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 1st Edition, 2003.
5. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, "Process Dynamics and Control", Wiley John and Sons, 4th Edition, 2016.

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/103104050
2. https://www.mathworks.com/matlabcentral/mlc downloads/downloads/submissions/10816/versions/1/previews/Mimotools/rga.m/index.htm
3. https://in.mathworks.com/help/ident

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	1	1	1	1	1	1	2	2	2
CO2	2	3	2	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	2	3	3	1	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
Avg	3	3	3	2.8	1	1	1	1	1	1	1	1	2	2	2

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23EEE53	SYSTEM IDENTIFICATION	L	T	P	C
		3	0	0	3

Course Objectives:

- To elaborate the concept of estimating the state variables of a system using state estimation algorithms.
- To elaborate the concept of estimating the parameters of the Input-output models using parameter estimation algorithms.
- To make the student understand the various closed loop system identification techniques.
- To make the student understand the various closed loop system identification techniques.
- To provide the background on the practical aspects of conducting experiments for real time system identification.

UNIT-I **NON PARAMETRIC METHODS** **(7+2 SKILL) 9**

Nonparametric methods: Transient analysis - frequency analysis - Correlation analysis - Spectral analysis.

UNIT-II **PARAMETRIC METHODS** **(7+2 SKILL) 9**

Parametric model structures: ARX, ARMAX, OE, BJ models - The Least square estimate - Best linear unbiased estimation under linear constraints - Updating the Parameter estimates for linear regression models - Prediction error methods: Description of Prediction error methods - Optimal Prediction – Relationships between prediction error methods and other identification methods - theoretical analysis. Instrumental variable methods: Description of Instrumental variable methods - Theoretical analysis - covariance matrix of IV estimates - Comparison of optimal IV and prediction error methods.

UNIT-III **RECURSIVE IDENTIFICATION METHODS** **(7+2 SKILL) 9**

The recursive least squares method - Recursive Instrumental variable method-the recursive prediction error method-model validation and model structure determination. Identification of systems operating in closed loop: Identifiability considerations - Direct identification - Indirect identification - Joint input – Output identification.

UNIT-IV **CLOSED- LOOP IDENTIFICATION** **(7+2 SKILL) 9**

Identification of systems operating in closed loop: direct identification and indirect identification – Subspace Identification methods: classical and innovation forms – Relay feedback identification of stable processes.

UNIT-V **NONLINEAR SYSTEM IDENTIFICATION** **(7+2 SKILL) 9**

Modeling of nonlinear systems using ANN- NARX & NARMAX - Training Feed-forward and Recurrent Neural Networks – TSK model – Adaptive Neuro-Fuzzy Inference System (ANFIS) - Introduction to Support Vector Regression.

TOTAL:45PERIODS

SKILL DEVELOPMENT ACTIVITIES:

(Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Familiarization of various system identification methods in MATLAB.
2. Seminar on ANFIS
3. Exploration of other advanced system identification methods.

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COURSE OUTCOMES:

The students will be able to:

CO1	Ability to design and implement state estimation schemes
CO2	Ability to develop various models (Linear & Nonlinear) from the experimental data.
CO3	Be able to choose a suitable model and parameter estimation algorithm for the identification of systems.
CO4	Be able to illustrate verification and validation of identified model
CO5	Ability to develop the model for prediction and simulation purposes using suitable control schemes.

TEXT BOOKS:

1. Lennart Ljung, "System Identification: Theory for the user", 2nd Edition, Prentice Hall, 1999.
2. Dan Simon, "Optimal State Estimation Kalman, H-infinity and Non-linear Approaches", John Wiley and Sons, 2006,
3. Tangirala, A.K., "Principles of System Identification: Theory and Practice", CRC Press, 2014, 1st Edition.

REFERENCES:

1. Cortes, C., and Vapnik, V., "Support-Vector Networks, Machine Learning", 1995, 1st Edition.
2. Miller, W.T., Sutton, R.S., and Webrose, P.J., "Neural Networks for Control", MIT Press, 1996, 1st Edition.
3. Van der Heijden, F., Duin, R.P.W., De Ridder, D., and Tax, D.M.J., "Classification, Parameter Estimation and State Estimation", An Engineering Approach Using MATLAB, John Wiley & Sons Ltd., 2017, 2nd Edition.
4. Karel J. Keesman, "System Identification an Introduction", Springer, 2011, 1st Edition.
5. Tao Liu and Furong Gao, "Industrial Process Identification and control design, Step-test and relay-experiment-based methods", Springer- Verlag London Ltd., 2012, 1st Edition.

List of Open Source Software/ Learning website:

1. https://in.mathworks.com/help/ident/
2. https://nptel.ac.in/courses/103106149
3. https://in.mathworks.com/help/curvefit/nonparametric-fitting.htm
4. https://nptel.ac.in/courses/111102143

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO4	3	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
Avg	3	2.6	2.6	2.6	1	1	1	1	1	1	1	1	2	2	2

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BoS / EEE

23EEE54	MODEL BASED CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

- To make the student to understand Multivariable and Multiloop Systems.
- To make the student to understand design a controller for MIMO systems.
- Understanding Model Predictive Control (MPC) Schemes and Elements:
- Exposure to State Space MPC and Case Studies.
- Knowledge of Various Constrained MPC.

UNIT-I INTRODUCTION TO MIMO CONTROL 9

Basic of MIMO Systems-Multivariable control-Multiloop Control-Multivariable IMC-IMCPID Case studies.

UNIT-II MODEL PREDICTIVE CONTROL SCHEMES 9

Model Predictive Control Elements - Generalized Predictive Control Scheme – Multivariable Generalized Predictive Control Scheme – Multiple Model based Model Predictive Control Scheme Case Studies.

UNIT-III STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME 9

State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State Observer Based Model Predictive Control Schemes – Case Studies.

UNIT-IV CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME 9

Constraints Handling: Amplitude Constraints and Rate Constraints –Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

UNIT-V ADAPTIVE CONTROL SCHEME 9

Introduction to Adaptive Control-Gain Scheduling-Self tuning regulators–MARS-Adaptive Model Predictive Control Scheme.

TOTAL:45PERIODS

COURSE OUTCOMES:

The students will be able to:

CO1	Ability to apply engineering knowledge to understand the control schemes on MIMO systems.
CO2	Ability to design a controller for MIMO systems.
CO3	Ability to analyze the control schemes available in industries.
CO4	Ability to design MPC (Model Predictive Control) and Adaptive controllers for practical engineering problems.
CO5	Ability to choose suitable controllers for the given problems.

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TEXT BOOKS:

1. Coleman Brosilow, Babu Joseph, "Techniques of Model-Based Control", Prentice Hall PTR Pub 2002, 1st Edition.
2. E. F. Camacho, C. Bordons ,"Model Predictive Control",Springer-Verlag London Limited 2007, 2nd Edition.
3. K.J. Astrom and B. J. Wittenmark, "Adaptive Control", Second Edition, Pearson Education Inc., second Edition 2013.

REFERENCES:

1. Paul Serban Agachi, Zoltan K. Nagy, Mircea Vasile Cristea, and Arpad Imre-Lucaci Model Based Control Case Studies in Process Engineering,WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim 2007.1st Edition.
2. Ridong Zhang, Anke Xue Furong Gao,"Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model",Springer Nature Singapore Pte Ltd. 2019, 1st Edition.
3. J.A. Rossiter "Model-Based Predictive Control A Practical Approach"Taylor & Francis eLibrary, 2005, 1st edition.

Online Sources :

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	1	1	1	1	1	2	2	-
CO2	3	2	3	1	1	1	1	1	1	1	1	1	2	2	-
CO3	2	2	2	1	1	1	1	1	1	1	1	1	2	2	-
CO4	2	2	3	1	1	1	1	1	1	1	1	1	2	2	-
CO5	3	2	3	1	1	1	1	1	1	1	1	1	2	2	-
Avg	3	2	2	1	1	1	1	1	1	1	1	1	2	2	-

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BoS / EEE

23EEE55	NON LINEAR CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter.

UNIT-I **STATE VARIABLE DESIGN** **(7+2 SKILL) 9**

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control.

UNIT-II **PHASE PLANE ANALYSIS** **(7+2 SKILL) 9**

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT-III **DESCRIBING FUNCTION ANALYSIS** **(7+2 SKILL) 9**

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT-IV **OPTIMAL CONTROL** **(7+2 SKILL) 9**

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.

UNIT-V **OPTIMAL ESTIMATION** **(7+2 SKILL) 9**

Optimal estimation – KalmanBucy Filter-Solution by duality principle-Discrete systems Kalman Filter-Application examples.

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES:

(Group Seminar/Mini Project/Assignment/ Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Design of linear quadratic regulator (LQR) control system for any application of your own
2. Familiarization of Kalman filter in MATLAB
3. Seminar on pole placement design

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COURSE OUTCOMES:

The students will be able to:

CO1	Able to apply the knowledge gained on state feedback control and nonlinear control.
CO2	Ability to carry out analysis for common nonlinearities in a system.
CO3	Apply advanced control theory to practical engineering problems.
CO4	Design optimal controller.
CO5	Understand the basics and Importance of Kalman filter.

TEXT BOOKS:

1. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House 1993.
2. M.Gopal, Modern Control System Theory, New Age International Publishers, 2002, 2nd 185 Edition.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006, 1st Edition.

REFERENCES:

1. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002, 1st Edition.
2. K. Ogata, 'Modern Control Engineering', 5th Edition, PHI, New Delhi, 2009.
3. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002, 1st Edition.
4. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009, 1st Edition.
5. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011, 2nd Edition.

List of Open Source Software/ Learning website:

1. https://in.mathworks.com/discovery/kalman-filter.html
2. https://in.mathworks.com/help/control/getstart/design-an-lqr-servo-controller-insimulink.html
3. https://onlinecourses.nptel.ac.in/noc22_ee24/preview
4. http://www.nitttrc.edu.in/nptel/courses/video/101108047/lec22.pdf

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
CO2	3	3	3	2	1	1	1	3	1	3	1	1	2	2	2
CO3	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
CO4	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
CO5	2	1	2	1	1	1	1	2	1	2	1	1	2	2	2
Avg	2.8	2.2	2.4	2	1	1	1	2.8	1	2.8	1	1	2	2	2

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23EEE56	OPTIMAL CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide an exposure to different type of optimal control problems such as time- optimal, fuel optimal, energy optimal control problems.
- To impart knowledge and skills needed to design Linear Quadratic Regulator for Time invariant and Time-varying Linear system (Continuous time and Discrete-time systems).
- To introduce concepts needed to design optimal controller using Dynamic Programming Approach and H-J-B equation.
- To provide an exposure to various types of fault tolerant control schemes such as Passive and active approaches.
- To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller.

UNIT-I CALCULUS OF VARIATIONS AND OPTIMAL CONTROL (7+2 SKILL) 9

Introduction – Performance Index- Constraints – Formal statement of optimal control system – Calculus of variations – Function, Functional, Increment, Differential and variation and optimum of function and functional – The basic variation problem Extrema of functions and functional with conditions – variational approach to optimal control system.

UNIT-II LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM (7+2 SKILL) 9

Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case- Time-invariant case – Stability issues of Time-invariant regulator – Linear Quadratic Tracking system: Fine time case and Infinite time case.

UNIT-III DISCRETE TIME OPTIMAL CONTROL SYSTEMS (7+2 SKILL) 9

Variational calculus for Discrete time systems – Discrete time optimal control systems:- Fixed final state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system – Steady state regulator system.

UNIT-IV PONTRYAGIN MINIMUM PRINCIPLE (7+2 SKILL) 9

Pontryagin Minimum Principle – Dynamic Programming:- Principle of optimality, optimal control using Dynamic Programming – Optimal Control of Continuous time and Discrete-time systems – Hamilton-Jacobi-Bellman Equation – LQR system using H-J-B equation.

UNIT-V CONSTRAINED OPTIMAL CONTROL SYSTEMS (7+2 SKILL) 9

Time optimal control systems – Fuel Optimal Control Systems- Energy Optimal Control Systems – Optimal Control Systems with State Constraints.

TOTAL:45PERIODS

SKILL DEVELOPMENT ACTIVITIES:

(Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Interactive MATLAB based project learning in an optimal control system.
2. Familiarize yourself with optimal control software tool boxes.
3. Arrange a group brainstorming process to generate new ideas and possible solutions to an optimal control problem in any field.

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4. Analyse the difference between optimal control systems with other types of control system.
5. Homework assignment on optimal control.

COURSE OUTCOMES:

The students will be able to:

CO1	Explain different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.
CO2	Design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems)
CO3	Design optimal controller using Dynamic Programming Approach and H-J-B equation.
CO4	Explain the Pontryagin Minimum Principle.
CO5	Design optimal controller in the presence of state constraints and time optimal controller.
CO6	Understand the concepts of dynamic programming

TEXT BOOKS:

1. Donald E. Kirk, Optimal Control Theory – An Introduction, Dover Publications, Inc. Mineola, New York, 2012, 10th Edition.

REFERENCES:

1. D. Subbaram Naidu, Optimal Control Systems, CRC Press, New York, 2003, 1st Edition.
2. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control, 3rd Edition, Wiley Publication, 2012, 3rd Edition.
3. Yan Wang, Cheng-Lin Liu, Zhi-Cheng Ji, Quantitative Analysis and Optimal Control of Energy Efficiency in Discrete Manufacturing System, Springer, 2020, 1st Edition.

List of Open Source Software/ Learning website:

1. https://in.mathworks.com/discovery/optimal-control.html#lqrlqg
2. https://www.codeproject.com/Articles/863257/Simple-Software-for-Optimal-Control
3. https://joss.theoj.org/papers/10.21105/joss.02809
4. https://www.ieee-ras.org/model-based-optimization-for-robotics/resources/optimization tools
5. https://www.vlab.co.in/
6. https://ocw.mit.edu/courses/16-323-principles-of-optimal-control-spring-2008/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	1	-	1	1	1	1	1	1	2	2	2
CO2	-	2	2	2	1	2	1	1	1	1	1	1	2	2	2
CO3	2	2	2	-	1	1	1	1	1	1	1	1	2	2	2
CO4	2	2	2	-	1	1	1	1	1	1	1	1	2	2	2
CO5	-	1	2	1	1	1	1	1	1	1	1	1	2	2	2
CO6	1	1	1	1	1	-	1	1	1	1	1	1	2	2	2
Avg	2	2	1.75	2	1	1.3	1	1	1	1	1	1	2	2	2

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23EEE57	ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart knowledge on how to recursively estimate the parameters of discrete input – output models using recursive parameter estimation methods
- To make the student understand the principles of STR, MRAC and Gain scheduling.
- To make the student design simple adaptive controllers for linear systems using STR, MRAC and Gain scheduling.

UNIT-I INTRODUCTION (7+2 SKILL) 9

Introduction - Adaptive Schemes - The adaptive Control Problem – Applications-Parameter estimation:-LS, RLS: and ERLS.

UNIT-II GAIN SCHEDULING (7+2 SKILL) 9

Introduction- The principle - Design of gain scheduling controllers- Nonlinear transformations - application of gain scheduling - Auto-tuning techniques: Methods based on Relay feedback.

UNIT-III DETERMINISTIC SELF-TUNING REGULATORS (7+2 SKILL) 9

Introduction- Pole Placement design - Indirect Self-tuning regulators - direct self-tuning regulators – Disturbances with known characteristics.

UNIT-IV STOCHASTIC AND PREDICTIVE SELF-TUNING REGULATORS (7+2 SKILL) 9

Introduction – Design of minimum variance controller - Design of moving average controller - stochastic self-tuning regulators.

UNIT-V MODEL – REFERENCE ADAPTIVE SYSTEM (7+2 SKILL) 9

Introduction- MIT rule – Determination of adaptation gain - Lyapunov theory –Design of MRAS using Lyapunov theory – Relations between MRAS and STR.

TOTAL :45PERIODS

SKILL DEVELOPMENT ACTIVITIES:

(Group Seminar/Mini Project/Assignment/ Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Learn any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Equivalent open source software)
2. Design of gain scheduling adaptive control using any one software tool
3. Analysis/Problem Solving - Ability to identify and define problems and solutions
4. Design and verification of MRAC by simulation.

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COURSE OUTCOMES:

The students will be able to:

CO1	Ability to apply the estimation algorithm to estimate the parameters of the process.
CO2	Ability to apply the adaptive control concepts to control a process.
CO3	Use appropriate software tools for design of adaptive controllers and analysis of the process.
CO4	Identify, formulate, carry out research by designing suitable adaptive schemes for complex instrumentation problem.
CO5	Apply the concepts to design adaptive control for multidisciplinary problem
CO6	Choose the techniques for self and lifelong learning to keep in pace with the new technology

TEXT BOOKS:

1. K.J. Astrom and B. J. Wittenmark, "Adaptive Control", Second Edition, Pearson Education Inc., second Edition 2013.

REFERENCES:

1. T. Soderstorm and Petre Stoica, "System Identification", Prentice Hall International(UK) Ltd., 1989, 1st Edition.
2. Lennart Ljung, "System Identification: Theory for the User", Second Edition, Prentice Hall, 1999.

List of Open Source Software/ Learning website:

1. https://archive.nptel.ac.in/courses/108/102/108102113/
2. https://in.mathworks.com/help/slcontrol/adaptive-control-design.html
3. https://in.mathworks.com/videos/nonlinear-model-based-adaptive-robust-controller in-an-oil- and-gas-wireline-operation-1637577967956.html
4. https://www.dynalog-us.com/adaptive-robot-control.htm
5. https://www.vlab.co.in/

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
CO2	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
CO3	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
CO4	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
CO5	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
CO6	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
Avg	3	2.3	2.3	2.3	1	1	1	3	1	1.6	1	1	2	2	2

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23EEE58	MACHINE MONITORING SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

- To make the students familiarize with the concept of condition-based maintenance for effective utilization of machines.
- To Impart the knowledge of artificial intelligence for machinery fault diagnosis.
- To give basic knowledge on vibration monitoring.
- To study the machinery vibrations using signal processing techniques.
- To provide knowledge on FMECA.

UNIT-I INTRODUCTION TO MACHINE CONDITION MONITORING (7+2 SKILL) 9

Machinery condition monitoring - Present status - Fault prognosis - Future needs.

UNIT-II MACHINERY MAINTENANCE (7+2 SKILL) 9

Maintenance strategies – Reactive, Preventive, and Predictive – Benefits of planned maintenance – Bath tub curve – Failure Modes Effects and Criticality Analysis (FMECA).

UNIT-III INTRODUCTION TO MACHINERY VIBRATION AND MONITORING (7+2 SKILL) 9

Characteristics of Vibration systems – Mode shapes & operational deflection shapes – Experimental modal analysis – Principles of vibration monitoring – Machinery faults diagnosed by vibration analysis.

UNIT-IV SIGNAL PROCESSING IN MACHINERY MONITORING (7+2 SKILL) 9

FFT analysis – Time domain analysis – Time-frequency analysis – Signal filtering – Cepstrum analysis – Health condition of compressor & engine.

UNIT-V MACHINE LEARNING FOR CONDITION MONITORING (7+2 SKILL) 9

Machine Learning: Feature extraction and feature selection methods – Feature reduction – Classification techniques – Case studies of condition monitoring in Nuclear plant components, Distillation column.

TOTAL :45PERIODS

SKILL DEVELOPMENT ACTIVITIES:

(Group Seminar/Mini Project/Assignment/ Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Survey of critical machinery that requires monitoring system.
2. Exposure to practical machinery vibration & monitoring system presently in use.
3. Carryout FMECA using software.
4. Analyze the health condition of any machinery.

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COURSE OUTCOMES:

The students will be able to:

CO1	Ability to identify the faults in machinery
CO2	Choose the proper maintenance strategies and condition monitoring techniques for identification of failure in a machine
CO3	Construct a classifier model for machine learning based fault diagnosis
CO4	Predict the faulty component in a machine by analyzing the acquired vibration signals .
CO5	Ability to analyze & build a model using modern tools.

TEXT BOOKS:

1. Cornelius Scheffer and PareshGirdhar, "Practical Machinery Vibration Analysis and Predictive Maintenance", Elsevier, 2004, 1st Edition.
2. A. R. Mohanty, "Machinery Condition Monitoring: Principles and Practices" , CRC Press, Taylor & Francis, 1st Edition, 2017.

REFERENCES:

1. Stephen Marsland, Machine Learning: An Algorithmic Perspective, 2nd Edition, 2014, CRC, Press.
2. Collacot, "Mechanical Fault Diagnosis and Condition Monitoring", Chapman- Hall, 1st Edition, 2011.
3. Davies, "Handbook of Condition Monitoring – Techniques and Methodology", Springer, 1st Edition, 2011.
4. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition 2011.
5. Ferdinand van der Heijden, Robert Duin, Dick de Ridder, David M. J. Tax, Classification, Parameter Estimation and State Estimation: An Engineering Approach Using MATLAB, John Wiley & Sons, 2nd Edition, 2017.

List of Open Source Software/ Learning website:

1. https://onlinecourses.nptel.ac.in/noc22_cs29/preview
2. https://www.udemy.com/topic/maintenance-management/
3. https://www.vi-institute.org/analyst-categories/
4. https://in.mathworks.com/help/predmaint/ug/condition-monitoring-and-prognostics-using vibration-signals.html

CO, PO & PSO MAPPING:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	1	1	1	1	1	1	1	1	1	2	2
CO3	3	3	3	3	1	1	1	1	1	1	1	1	1	2	2
CO4	2	2	1	2	1	1	1	1	1	1	1	1	1	2	2
CO5	3	3	3	2	1	1	1	1	1	1	1	1	1	2	2
Avg	2.4	2.2	2	2	1	1	1	1	1	1	1	1	1	2	2

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23EEE61	ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the significance of energy storage schemes.
- Understand the concepts of various models of batteries
- Understand the principles of different methods of thermal energy storage schemes
- Understand the performance of passive energy storage elements.
- Understand the different methods of energy storage technologies with applications.

UNIT-I MODES OF STORAGE 9

Need and importance of Energy storage, opportunities in energy storage, Modes of Storage: Thermo-chemical energy storage, Energy Storage in Organic Fuels, Hydrogen Storage, Bio Fuel Cell and Green Battery storage - Comparison of different energy storage technology.

UNIT-II ELECTROCHEMICAL ENERGY STORAGE SYSTEMS 9

Batteries: Basic concepts -Working principle of battery -Battery performance - Safety issues. Types of Batteries: Primary, Secondary, Lithium, Solid – state and Molten solvent batteries; Lead acid batteries - Sodium ion batteries - Modern Batteries – Battery management system - Energy management system.

UNIT-III THERMAL ENERGY STORAGE 9

Basic Principles - Benefits - Heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage Methods - Sensible Thermal Energy Storage (TES)- Latent TES – Cold TES - - Seasonal TES.

UNIT-IV ELECTROMAGNETIC ENERGY STORAGE SYSTEMS 9

Electrochemical Double Layer Capacitor (EDLC):principle of working, structure, performance and applications, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems, and future prospects of electrochemical storage systems.

UNIT-V ENERGY STORAGE TECHNOLOGIES AND APPLICATIONS 9

Fuel cells: Principle - Difference between batteries and fuel cells - Types of Fuel cells. Flywheel energy storage – Pumped storage system - Hydraulic storage - Applications: Power plant applications, Green house heating, Heating applications in Industry.

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Justify the significance of energy storage in current scenario
CO2	Compare the working methods of various electrochemical batteries.
CO3	Analyse the various methods of thermal energy storage systems.
CO4	Apply the principle of Electromagnetism for energy storage
CO5	Explain the working of fuel cells, flywheel and evaluate the energy storage technologies for power plant and heating applications.

TEXT BOOKS:

1. S.R. Khalid, " Energy Storage Systems: Operation and Control", CRC Press, 1st Edition, 2023.
2. Bengt Sunden and Mohammad Reza Ghalambor, "Handbook of Energy Storage: Types, Technologies and Applications", Springer, 1st Edition, 2020.
3. Huggins, Robert A., Energy Storage: Fundamentals, Materials and Applications, Second Edition, Springer US, 2020.

REFERENCES:

1. Glaize, C, "Lithium Batteries and other Electrochemical Storage Systems", Wiley Publications,
2. Ru - shiliu, Leizhang and Xueliang sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley publications, 2020
3. Paul Denholm, Erik Ela, Brendan Kirby and Michael Milligan, "The Role of Energy Storage with Renewable Electricity Generation", National Renewable Energy Laboratory (NREL) -a National Laboratory of the U.S. Department of Energy

ONLINE SOURCES

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO& PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	3
CO2	3	-	2	-	-	-	-	-	-	-	-	-	1	-	2
CO3	3	-	1	-	-	-	-	-	-	-	-	-	3	-	3
CO4	2	-	2	-	-	-	-	-	-	-	-	-	2	-	1
CO5	3	3	2	-	-	2	-	1	-	-	-	-	2	-	3
Avg	2.6	2	1.7	-	-	2	-	1	-	-	-	-	-	-	2.4

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23EEE62	HYBRID ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

- Describe the principles, components, and applications of solar, wind, hydro, biomass, and geothermal energy sources.
- Understand the benefits and challenges, and identify different types of hybrid systems
- Explain the role of power electronic converters in hybrid systems
- Understand the various energy storage options.
- To analyze the performance of the various hybrid energy systems

UNIT-I INTRODUCTION TO RENEWABLE ENERGY TECHNOLOGIES 9

Overview of energy scenario of renewable and non-renewable energy sources - type renewable energy sources - Solar energy: PV systems, solar thermal systems - Wind energy: Wind turbines, wind farms- Hydro energy: Hydropower plants, micro-hydro systems - Biomass energy: Biofuels, biogas - Geothermal energy: Geothermal power plants

UNIT-II HYBRID ENERGY SYSTEMS 9

Definition and concepts of hybrid energy systems - Range and types of hybrid PV systems - Benefits and challenges of hybrid energy-Components of hybrid energy systems-Generators, storage systems, control systems, and grid connection -,wind- diesel hybrid systems, PV-Wind-Battery & grid interacted hybrid system - Co-generation.

UNIT-III ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS 9

Line commutated converters (inversion-mode) –Buck,Boost and buckboost converters- Cuk converter - Types of Solar PV systems: Stand-alone PV systems- Design of PV standalone system - AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Grid-Interactive Inverters - Matrix converter – Merits and Limitations.

UNIT-IV ENERGY STORAGE TECHNOLOGIES 9

Battery technology: Lead-acid, lithium-ion, flow batteries - Pumped hydro storage - Thermal energy storage (TES): Phase change materials, sensible heat storage - Other storage technologies.

UNIT-V CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS 9

Environmental impact assessment - Case studies of Wind-PV, Diesel-PV, Micro-hydel-PV, Biomass-Diesel, PV- wind – Fuel cell systems.

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Examine the various renewable energy sources
CO2	Apply theoretical knowledge to understand hybrid systems for various applications
CO3	Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for Hybrid energy systems.
CO4	Choose suitable renewable energy storage options based on specific project requirements and constraints
CO5	Interpret the hybrid renewable energy systems

TEXT BOOKS:

1. Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", CRC Press, First Edison, 2021
2. Timothy C. Green," Hybrid Power Systems:Principles, Design, and Applications" (3rd edition), CRC Press, 2019
3. Gregory P. Tsatsaronis and Michael J. Assanis,Renewable Energy Engineering: A Comprehensive Approach (2nd edition),Academic Press, 2017

REFERENCES:

1. Rashid.M. H "Power electronics Hand book", Academic press,4th Edition, 2018.
2. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.
3. B.H.Khan "Non-conventional Energy sources", Tata McGraw hill Publishing Company, New Delhi, 2017, 3rd Edition.

ONLINE SOURCES

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO& PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	-	-	-	-	-	3	-	1	3	3	1
CO2	2	3	2	1	3	-	-	-	-	2	-	3	2	3	2
CO3	2	3	3	3	2	-	-	-	-	3	-	2	2	2	2
CO4	3	3	3	2	3	-	-	-	-	2	-	1	3	1	3
CO5	3	1	2	2	-	-	-	-	-	1	-	3	3	3	3
Avg	2.6	2.4	2.6	2	2.6	-	-	-	-	2.2	-	2	2.8	2.4	2.2

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23EEE63	DESIGN AND MODELLING OF RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the fundamentals of renewable energy systems
- Acquire proficiency in modeling and simulation
- To learn the Single phase grid-connected photovoltaic systems photovoltaic systems
- To learn the three phase grid-connected photovoltaic systems
- To illustrate the wind energy systems

UNIT-I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS 9

Definition and concepts of renewable energy - Types of renewable energy sources- solar, wind, hydro, biomass, geothermal - Benefits and challenges of renewable energy- Future Trends.

UNIT-II BASICS OF MODELING METHODS 9

Introduction to modelling and simulation software - MATLAB, Simulink - System design methodologies - top-down, bottom-up - SIMULINK design of Output Current Equation - Application of modeling and simulation tools for renewable energy system design and analysis

UNIT-III SOLAR ENERGY SYSTEMS 9

Solar photovoltaic (PV) technology – basic concept -Solar PV system components - panels, inverters, batteries, charge controllers - Solar PV system design and sizing - Demands for Grid-Connected PV Systems-Power Converter Technology for Single Phase PV Systems, Transformer less AC-Module Inverters .

UNIT-IV THREE-PHASE PHOTOVOLTAIC SYSTEMS 9

Control Building Blocks for PV Inverters, Modulation Strategies for Three-Phase PV Inverters - Grid Synchronization, Implementation of the PLLs for Grid Synchronization, Current Control - Maximum Power Point Tracking – P&O, Incremental Conductance method.

UNIT-V WIND ENERGY SYSTEMS 9

Wind energy conversion system – basic concept - Wind turbine components - blades, nacelle, tower - Generator Selection for Small-Scale Wind Energy Systems- Turbine Selection for Wind Energy- Wind turbine modeling and simulation

TOTAL :45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1 Review the perspectives of renewable energy systems

CO2 Design and analyze renewable energy systems

CO3 Integrate photovoltaic systems with grid

CO4 Study inverter for PV systems

CO5 Elaborate the working of wind power systems

TEXT BOOKS:

1. Ahmad Azar, Nashwa Kamal, "Design, Analysis and Applications of Renewable Energy Systems", Academic Press, Second Edition, 2023
2. Ahmad Azar, Nashwa Kamal, "Renewable Energy Systems", Academic Press, First Edition, 2021
3. Nabil Derbel, QuanminZhuModeling, "Identification and Control Methods in Renewable Energy Systems" , Springer, second Edition, 2021

REFERENCES:

1. Power Conversion and Control of Wind Energy Systems, Bin Wu, 2022, Wiley-IEEE, 3rd Edition.
2. Wind Electrical Systems, S.N. Bhadra, 2021, Oxford, 9th Impression.
3. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2019, IET, 4th Edition.

ONLINE SOURCES

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO& PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	3
CO2	2	2	3	3	-	-	-	-	-	-	-	-	3	3	1
CO3	3	1	3	2	2	-	-	-	-	-	-	-	1	3	2
CO4	3	2	2	1	-	-	-	-	-	-	-	-	1	2	3
CO5	3	2	3	3	2	-	-	-	-	-	-	-	3	3	3
Avg	2.8	1.7	2.7	2.25	2	-	-	-	-	-	-	-	2.2	2.75	2.4

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23EEE64	GRID INTEGRATING TECHNIQUES AND CHALLENGES	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the principles of integrating renewable energy sources into the grid.
- Understand the techniques of integrating renewable energy sources into the grid.
- Evaluate the role of energy storage systems in grid integration.
- Analyze the challenges associated with grid integration and their solutions
- Examine the future trends and challenges in grid integration.

UNIT-I INTRODUCTION TO GRID INTEGRATION 9

Introduction - Grid structure and components - Challenges of integrating variable renewable energy sources - Grid codes and standards - Role of grid operators

UNIT-II GRID INTEGRATION TECHNIQUES 9

Frequency control and voltage regulation - Reactive power management - Power system stability analysis - Phasor measurement unit (PMU) applications

UNIT-III ENERGY STORAGE SYSTEMS FOR GRID INTEGRATION 9

Types of energy storage - battery, pumped hydro, thermal - Applications of energy storage in grid integration - Economic viability of energy storage

UNIT-IV GRID INTEGRATION CHALLENGES AND SOLUTIONS 9

Intermittency and variability of renewable energy - Ramp rate challenges - Grid congestion and curtailment - Cyber security threat

UNIT-V FUTURE TRENDS AND CHALLENGES 9

Advancements in grid integration technologies - Role of artificial intelligence and IoT in grid management - Impact of climate change on grid integration

TOTAL :45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Understand the fundamental principles for integrating renewable energy sources into the electrical grid.
CO2	Understand the techniques for integrating renewable energy into grid.
CO3	Evaluate the role of energy storage systems in enhancing grid stability and reliability during the integration of renewable energy
CO4	Analyze the technical and operational challenges associated with grid integration and propose effective solutions
CO5	Explore the future trends and challenges in grid integration, including the role of emerging technologies and policy developments.

TEXT BOOKS:

1. Brian D'Andrade "The Power Grid", Academic Press, 1st Edition, 2017.
2. T. Ackermann, J. B. Cardell, and J. W. Taylor," Grid Integration of Renewable Energy Systems",2nd edition, 2018
3. Siegfried Heier, "Grid Integration of Wind Energy: Onshore and Offshore Conversion Systems", John Wiley & Sons, Ltd, 2014, 3rd Edition.

REFERENCES:

1. Integration of Renewable Energy Sources with Smart Grid, M. Kathiresh, A. Mahaboob Subahani, and G.R. Kanaga chidambaresan, Scrivener & Wiley, 2021, 1st Edition.
2. Control and Operation of Grid-Connected Wind Energy SysteM Ali M. Eltamaly, Almoataz Y. Abdelaziz, Ahmed G. Abo-Khalil, Springer 2021, 1st Edition.
3. Design of smart power grid renewable energy systems, Third Edition, Ali Keyhani, Wiley

ONLINE SOURCES

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	3	-	1	3	3	-
CO2	3	-	2	-	3	-	-	-	-	3	-	3	2	3	-
CO3	1	3	3	-	3	-	-	-	-	2	-	2	2	2	-
CO4	2	2	1	3	1	-	-	-	-	3	-	2	3	1	-
CO5	3	3	2	3		-	-	-	-	1	-	3	3	3	-
Avg	2.4	2.6	2	3	2.3	-	-	-	-	2.4	-	2.2	2.6	2.4	-

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23EEE65	SUSTAINABLE AND ENVIRONMENTAL FRIENDLY HV INSULATION SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the fundamentals of high voltage insulation
- Gain knowledge of sustainable and environmentally friendly insulation materials
- To learn about Green Gaseous insulators.
- To learn about Green liquid insulators.
- To learn about Green solid insulators.

UNIT-I SUSTAINABLE AND ENVIRONMENTAL ENERGY AND PRODUCTS 9

Introduction to Sustainable energy, Carbon print, global warming potential, environment requirement for any product and system.

UNIT-II ALTERNATE GREEN GASEOUS INSULATORS 9

Green Gas for Grid as an Eco-Friendly Alternate- SF6 gas and its hazardous environmental effects, alternate gases, gaseous mixtures and other sources and it's properties.

UNIT-III ALTERNATE GREEN LIQUID INSULATORS 9

Introduction to liquid insulation: Properties, applications, and challenges of organic oil - Benefits of alternate green liquid insulators: Environmental impact, safety, and performance advantages - Types of alternate green liquid insulators - ester oil, vegetable oils

UNIT-IV ALTERNATE GREEN SOLID INSULATORS 9

Introduction to solid insulation: Properties, applications, and challenges of traditional solid insulators - Benefits of alternate green solid insulators: Environmental impact, safety, and advantages

UNIT-V EVOLVING STANDARDS FOR GREEN INSULATION SYSTEMS 9

Green Building Standards And Certification Systems - Green Codes-environmental protection.

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1 Design and analyze sustainable insulation systems

CO2 Select appropriate sustainable insulation materials

CO3 Describe the alternate green gaseous insulators

CO4 Describe the alternate green liquid insulators

CO5 Describe the alternate green sold insulators

TEXT BOOKS:

1. R. Bartnikas and R. M. Hill, "Electrical Insulation: Theory and Practice".
2. E. Kuffel, W. S. Zaengl, and J. K. Nelson,"Insulation Coordination".
3. Sustainable, Renewable and Environmental-Friendly Insulation Systems for High Voltages Applications by RafiqShafique, et al. (MDPI).
4. Green Liquid Insulators for High Voltage Applications: A Review by A. Kumar, et al. (IEEE Transactions on Dielectrics and Electrical Insulation)
5. Nanoparticle-Enhanced Natural Esters for High Voltage Insulation: A Review by H. Wang, et al. (IEEE Transactions on Dielectrics and Electrical Insulation)

REFERENCES:

1. IEEE Transactions on Dielectrics and Electrical Insulation
2. IEEE Electrical Insulation Magazine
3. Google Scholar (for searching specific research papers and articles)

ONLINE SOURCES

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO& PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	2	-	-	-	-	-	3	-	3
CO2	2	-	1	-	-	-	3	-	-	-	-	-	2	-	3
CO3	1	-	3	-	-	-	1	-	-	-	-	-	3	-	2
CO4	3	-	3	-	-	-	2	-	-	-	-	-	2	-	2
CO5	3	-	2	-	-	-	3	-	-	-	-	-	3	-	3
Avg	2.4	-	2.2	-	-	-	2.2	-	-	-	-	-	2.8	-	2.6

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23EEE66	POWER SYSTEM TRANSIENTS	L	T	P	C
		3	0	0	3

Course Objectives:

- Generation of switching transients and their control using circuit – theoretical concept.
- Mechanism of lighting strokes and the production of lighting surges.
- Propagation, reflection and refraction of travelling waves.
- Voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT-I INTRODUCTION 9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems.

UNIT-II SWITCHING TRANSIENTS 9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping. Capacitance switching- Ferro resonance.

UNIT-III LIGHTNING TRANSIENTS 9

Introduction, Scope of Lightning Problem, The Physical phenomena of lightning phenomenon, charge formation in the clouds, rate of charging of thunder clouds, mechanisms of lighting strokes, Computation of a Specific lightning Events, Induced Lightning Surges, Protection afforded by ground wires, Tower footing resistance.

UNIT-IV TRAVELLING WAVES ON TRANSMISSION LINE 9

Traveling waves in transmission lines, Reflection and refraction of waves, Typical cases and effects of line terminators, Equivalent circuit for traveling wave studies, Forked line , Reactive termination, Bewley lattice diagram, Multi conductor systems.

UNIT-V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault - distribution of voltages in a power system – Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults.

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Ability to understand and analyze switching and lightning transients
CO2	Ability to acquire knowledge on generation of switching transients and their control
CO3	Understand Lightning and effect on power systems.
CO4	Ability to understand the importance of propagation, reflection and refraction of travelling waves.
CO5	Ability to find the voltage transients caused by faults, and to understand the concept of circuit breaker action, load rejection on integrated power system

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York,
   2022 .
2. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2023.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2020

REFERENCES:

1. Akihiro ametani," Power System Transient theory and applications", CRC press, 2022.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc.,
   Second Edition, 2020.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2023.

ONLINE SOURCES

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CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	-	-	-	-	-	-	-	-	3	2	2
CO2	3	1	2	3	-	-	-	-	-	-	-	-	3	2	1
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	1	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	2	2	-
CO5	2	3	2	2	-	-	-	-	-	-	-	-	3	1	-
Avg	2.8	2.4	2.2	2.6	-	-	-	-	-	-	-	-	2.8	1.6	1.5

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23EEE67	PLC PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand basic PLC terminologies digital principles, PLC architecture and operation.
- Develop PLC logic for simple applications using ladder logic.
- Ability to understand the SCADA technique
- Understand the hardware and software behind PLC and SCADA.
- Familiarize different programming language of PLC.

UNIT-I **INTRODUCTION TO PLC** **9**

Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers / DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, PLC Special I/O, PLC Types.

UNIT-II **PLC INSTRUCTIONS** **9**

PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays.

UNIT-III **SCADA** **9**

Elements of SCADA system- History of SCADA, Remote Terminal Unit- Discrete control- Analog control, Master Terminal Unit- Operator interface.

UNIT-IV **COMMUNICATION OF PLC AND SCADA** **9**

Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures

UNIT-V **PLC PROGRAMMING** **9**

Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Know the basic requirement of a PLC input/output devices and architecture.
CO2	Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming
CO3	Apply the knowledge to design or improve an existing program to increase productivity of any process
CO4	Apply combined SCADA architecture and communication protocols.
CO5	Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function BIock

TEXT BOOKS:

1. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2019.
2. Stuart Boyer A, "SCADA: Supervisory control and data Acquisition", Fourth Edition, ISA- The Instrumentation, Systems, and Automation Society,2010
3. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication

REFERENCES:

1. Bolton. W, "Programmble Logic Controllers" , Elsevier Newnes, 6th Edition 2015
2. Madhuchannd Mitra and Samerjit Sengupta, Programmable Logic Controllers Industrial Automation an Introduction, Penram International Publishing Pvt. Ltd.
3. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles and Applications, Pearson publication

ONLINE SOURCES

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	3	2	-	-	-	-	1		1	2	-	-	2	-
CO3	3	2	2	2	-	-	-	1		1	-	-	-	-	-
CO4	3	3		3	3	-	-	1		1	-	-	3	3	-
CO5	3	3	3	3	1	-	-	1		1	-	-	-	-	-
Avg	3	2.9	-	-	1.6	-	-	1		1	2	-	3	2.5	-

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23EEE68	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand big data.
- To learn and use NoSQL big data management.
- To learn mapreduce analytics using Hadoop and related tools.
- To work with map reduce applications
- To understand the usage of Hadoop related tools for Big Data Analytics

UNIT-I **UNDERSTANDING BIG DATA** **6**

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

UNIT-II **NO SQL DATA MANAGEMENT** **6**

Introduction to No SQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra client

UNIT-III **MAP REDUCE APPLICATIONS** **6**

Map Reduce workflows – unit tests with MR Unit – test data and local tests – anatomy of Map Reduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – Map Reduce types – input formats – output formats.

UNIT-IV **BASICS OF HADOOP** **6**

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra –Hadoop integration

UNIT-V **HADOOP RELATED TOOLS** **6**

H base – data model and implementations – H base clients – H base examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – Hive QL data definition – Hive QL data manipulation – Hive QL queries.

TOTAL : 30 PERIODS

LIST OF EXPERIMENTS: **30 PERIODS**

1. Downloading and installing Hadoop; Understanding different Hadoop modes.
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files

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3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5. Collect and clean data from a website.

TOTAL: 60 PERIODS

COURSE OUTCOMES

The students will be able to:

CO1	Describe big data and use cases from selected business domains.
CO2	Explain NoSQL big data management.
CO3	Install, configure, and run Hadoop and HDFS.
CO4	Perform map-reduce analytics using Hadoop.
CO5	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

TEXT BOOKS:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Sadalage, Pramod J. "NoSQL distilled", 2013
4. SVHEC lab Manual

REFERENCES:

1. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.

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CO, PO & PSO MAPPING

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CO2	3	3	2	3	2	-	-	-	2	2	3	3	2	3	2
CO3	3	3	3	2	3	-	-	-	2	2	1	2	2	3	3
CO4	2	3	3	3	3	-	-	-	2	2	3	2	3	3	2
CO5	3	3	3	3	3	-	-	-	3	1	3	2	3	2	3
Avg	2.8	3	2.8	2.8	2.8	-	-	-	2.2	1.8	2.6	2	2.2	2.8	2.6

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23MDC51	SOFT SKILLS AND ANALYTICAL SKILLS - II	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- ☐ To enhance the collaboration and cooperation between individuals towards a common goal.
- ☐ To provide a critical perspective on the socialization of men and women.
- ☐ Basic Knowledge about the Verbal Reasoning.
- ☐ To solve the problems in Quantitative Aptitude.
- ☐ Understand the basics of Data Interpretation

UNIT-I **TEAM SKILLS** **3**

Trust and collaboration - Team building – Shouldering responsibilities

UNIT-II **GENDER SENSITIZATION** **3**

Media and the Social Context - Social Networks - Gender Sensitization

UNIT-III **VERBAL REASONING** **3**

Verbal Reasoning: Syllogism, Blood relationship

UNIT-IV **QUANTITATIVE APTITUDE** **3**

Ratio and proportion, Problems on ages, Partnership.

UNIT-V **DATA INTERPRETATION** **3**

Tabulation – Profit & loss, Percentage.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Share and exchange knowledge and ideas, clarify doubts, and arrive at a collective decision or understanding.

CO2 : Meet the needs of an increasingly ethnically and gender-diverse workplace.

CO3 : Enhance the Aptitude Round Clearing ability in interview process

CO4 : Solve problems pertaining to quantitative ability.

CO5 : Interrupt the data.

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TEXT BOOKS:

1. Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.
2. Soft Skills: an Integrated Approach to Maximise Personality, Gajendra S. Chauhan, Sangeeta Sharma, Wiley India

REFERENCE BOOKS:

1. Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar, New Delhi-110055
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude for Competitive Examination by AbhijitGuha, Tata Mc Graw Hill Publications.
4. Personality Development and Soft Skills, Barun K. Mitra, Oxford Press
5. Cornerstone: Developing Soft Skills, Sherfield, Pearson India

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