Sri

SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

West Tambaram, Chennai - 44

www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University



DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

AUTONOMOUS

CURRICULUM AND

SYLLABUS I - V

SEMESTERS

REGULATIONS 2024

Academic Year 2024-25 onwards

SRI SAIRAM ENGINEERING COLLEGE

VISION

To emerge as a "Centre of excellence " offering Technical Education and Research opportunities of very high standards to students, develop the total personality of the individual and instil high levels of discipline and strive to set global standards, making our students technologically superior and ethically stronger, who in turn shall contribute to the advancement of society and humankind.

MISSION

We dedicate and commit ourselves to achieve, sustain and foster unmatched excellence in Technical Education. To this end, we will pursue continuous development of infra-structure and enhance state-of-the-art equipment to provide our students a technologically up-to date and intellectually inspiring environment of learning, research, creativity, innovation and professional activity and inculcate in them ethical and moral values.

Educational Organization Management System (EOMS) Policy

We at Sri Sai Ram Engineering College are committed to empower our students not only to excel academically but also imbibe essential values, enabling them to become exemplary global citizens. We build a better nation by fostering excellence and innovative practices in Engineering, Technology and Management Education. We are dedicated to consistently enhancing our systems, infrastructure and services to meet the needs and expectations of all our stakeholders for sustainable growth

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

VISION

To inculcate discipline, good quality education, research and training, wide knowledge to meet the global standards, opportunities to gain practical knowledge in the laboratories, awareness in emerging technologies in students to render their services for the betterment of the society with ethics.

MISSION

To provide a platform in acquiring knowledge in the field of Electrical and Electronics Engineering with highest quality in technical education and services to the society. To fulfill the needs:

1. To provide best teaching and mentoring through ethical and moral values.
2. To provide quality education for Electrical and Electronics Engineers that prepares them for exemplary life-long career and professional growth.
3. To develop cutting edge technologies through research that meets the needs of industry, government and the scientific community.
4. To guide our graduates to pursue their formal education further, including PG and PhD programmes.
5. To excel in student learning activities, to produce them as problem solvers as a team or individual by active interaction and effective communication with peers and stakeholders.

AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2024

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24BSMA101	Matrices and Calculus	3	1	0	4	4
2	24HSEN101	Communicative English	3	0	0	3	3
3	24BSPH101	Engineering Physics	3	0	0	3	3
4	24BSCY101	Engineering Chemistry	3	0	0	3	3
5	24ESCS101	Problem Solving and Programming in C	3	0	0	3	3
6	24ESGE101	Engineering Graphics	1	2	0	3	3
7	24HSTA101	Heritage of Tamils	1	0	0	1	1
PRACTICALS							
1	24BSPL101	Physics and Chemistry Laboratory	0	0	4	4	2
2	24ESPL101	Programming in C Laboratory	0	0	2	2	1
VALUE ADDITIONS - I							
1	24ENTP101	Functional Life Skills	1	0	1	2	1
2	24ESID101	Idea Engineering Lab - I	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		Recommended by BoS					
					Total	**30**	**25**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24BSMA202	Differential Equations, Complex Variables and Transforms	3	1	0	4	4
2	24HSEN201	Professional English	2	0	0	2	2
3	24BSPH201	Physics of Electronic Devices	3	0	0	3	3
4	24BSCY201	Chemistry for Environment and Sustainability	3	0	0	3	3
5	24EEPC201	Circuit Theory	2	1	0	3	3
6	24HSTA201	Tamils and Technology	1	0	0	1	1
7	24HSNC201	NCC Course Level 1*	2*	0	0	2*	0
PRACTICALS							
1	24ESGE102	Engineering Practices Laboratory	0	0	4	4	2
VALUE ADDITIONS - II							
1	24ENTP201	Digital Dynamics	0	0	2	2	0
2	24ESID201	Idea Engineering Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24ESMC201	MS Office (Mandatory - NC)	0	0	0	0	0
		*only for NCC cadets			**Total**	**24**	**19**

Approved by
Academic Council Meeting
No. 08 Dated: 03.09.2024

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Board of Studies
Electrical and Electronics Engineering

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SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24BSMA302	Linear Algebra and Partial Differential Equations	3	1	0	4	4
2	24EEPC301	Electromagnetic Fields	3	0	0	3	3
3	24EEPC302	Electrical Machines - I	3	0	0	3	3
4	24EEPC303	Analog Electronics	3	0	0	3	3
5	24EEPC304	Digital Electronics	3	0	0	3	3
6	24HSMC301	Universal Human Values - II Understanding Harmony	3	0	0	3	3
7	24HSNC301	NCC course Level 2*	3*	0	0	3*	0
PRACTICALS							
1	24EEPL301	Analog and Digital Electronics Laboratory	0	0	4	4	2
VALUE ADDITIONS - III							
1	24EETP301	Aptitude Skills - I	0	0	2	2	1
2	24EEID301	Innovative Design Lab - I	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24ESMC301	Joy of Computing using Python (Mandatory - NC)	0	2	0	2	0
				Total		**29**	**23**

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24BSMA403	Statistics and Numerical Methods	3	1	0	4	4
2	24EEPC401	Transmission and Distribution	3	0	0	3	3
3	24EEPC402	Electrical Machines - II	3	0	0	3	3
4	24EEPC403	Measurements and Instrumentation	3	0	0	3	3
5	24EIPC404	Control Systems	3	1	0	4	3
6	24MGOE9xx	Open Elective - I #	3	0	0	3	3
7	24HSNC401	NCC course Level 3*	3	0	0	3#	0
PRACTICALS							
1	24EEPL401	Control and Instrumentation Laboratory	0	0	4	4	2
2	24EEPL402	Electrical Machines Laboratory	0	0	4	4	2
VALUE ADDITIONS - IV							
1	24EETP401	Aptitude Skills - II	0	0	2	2	0
2	24EEID401	Innovative Design Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		Recommended by BoS		**Total**		**32**	**24**

*Only for NCC Cadets, to be conducted beyond working hours # Fundamentals of Supply Chain and Logistics Management

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SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24EEPC501	Power System Analysis	3	0	0	3	3
2	24EEPC502	Power Electronics	3	0	0	3	3
3	24EEEL5xx	Domain Group - I	3	0	0	3	3
4	24EEPL5xx	Domain Group - II	3	0	0	3	3
5	24SCOE9yy	Open Elective - II#	3	0	0	3	3
6	24MGMC501	Constitution of India	2	0	0	2	0
PRACTICALS							
1	24EEPL501	Power Electronics Laboratory	0	0	4	4	2
2	24EEPT501	Microprocessors and Microcontrollers Laboratory with Theory	1	0	4	5	3
VALUE ADDITIONS - V							
1	24EETP501	Skill Enhancement	0	0	2	2	1
2	24EEID501	Prototype Development Lab - I	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by Dean Academic			Total	30	22

Social Media Overview and Security

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24EEPC601	Power System Operation and Control	3	0	0	3	3
2	24EEPC602	Embedded Systems	3	0	0	3	3
3	24EEEL6xx	Domain Group -I	3	0	0	3	3
4	24EEEL6yy	Domain Group-II	3	0	0	3	3
5	24xxOE9xx	Open Elective-III	3	0	0	3	3
6	24HSMG501	Principles of Engineering Management	3	0	0	3	3
PRACTICALS							
1	24EEPL601	Power System Simulation Laboratory	0	0	4	4	2
VALUE ADDITIONS - VI							
1	24EETP601	Technical Skill	0	0	2	2	0
2	24EEID601	Prototype Development Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by Dean Academic			Total	26	21

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SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24EEPC701	Electric Vehicles	3	0	0	3	3
2	24EEEL7xx	Domain Group -I	3	0	0	3	3
3	24EEEL7yy	Domain Group-II	3	0	0	3	3
4	24XXOE9xx	Open Elective-IV	3	0	0	3	3
5	24MGEL703	Creative Innovation and Entrepreneurship	2	0	0	2	2
PRACTICALS							
1	24EEPT701	Renewable Energy Laboratory with Theory	1	0	4	5	3
2	20EEPJ701	Project Work - Phase I	0	0	8	8	4
VALUE ADDITIONS - VII							
1	24EETP701	Company Specific Skills	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by Dean Academic			**Total**	**29**	**22**

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24EEEL8XX	Domain Group - I & II	3	0	0	3	3
PRACTICALS							
1	24EEPJ801	Project Work - Phase II	0	0	12	12	6
VALUE ADDITIONS - VIII							
1	24EEIN801	Internship	0	0	9	9	3
					Total	**24**	**12**

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Electrical and Electronics Engineering

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DOMAIN GROUP - I : GREEN ENERGY

S. NO	COURSE CODE	COURSE TITLE	CREDIT	PREREQUISITE COURSES
1	24EEEL501	Solar Energy Systems	3	24EEPC201,24EEPC401
2	24EEEL502	Biomass Energy Systems	3	24EEPC201, 24BSCY201, 24EEPC401
3	24EEEL503	Small Hydro and Ocean Energy Systems	3	24EEPC201,24EEPC401
4	24EEEL515	Nuclear Energy Systems	3	24EEPC201, 24BSCY201, 24EEPC401
5	24EEEL516	Fundamentals of Energy and Environment	3	24BSCY201
6	24EEEL517	Wind Energy Conversion Systems	3	24EEPC402

DOMAIN GROUP - I : POWER ELECTRONICS

S. NO	COURSE CODE	COURSE TITLE	CREDIT	PREREQUISITE COURSES
1	24EEEL504	Power Electronics Applications in Power Systems	3	24EEPC201, 24EEPC303, 24EEPC304
2	24EEEL505	SMPS and UPS	3	24EEPC201, 24ESEE401
3	24EEEL506	Design and Analysis of DC-DC converter	3	24EEPC201
4	24EEEL518	Line Commutated and PWM Rectifiers	3	24EEPC201, 24EEPC303
5	24EEEL519	Analysis of Inverters	3	24EEPC201, 24BSPH201
LABORATORY WITH THEORY				
6	24EEEP503	Power Electronics for sustainable Energy Technologies Laboratory with Theory	3	24EEPL301

DOMAIN GROUP - I : POWER SYSTEMS

S. NO	COURSE CODE	COURSE TITLE	CREDIT	PREREQUISITE COURSES
1	24EEEL507	Energy Efficient Illumination Systems	3	24EEPC201
2	24EEEL508	Sustainable Power Generation	3	24EEPC201,24EEPC401
	24EEEL509	Energy Economics and Policy	3	24EEPC401
4	24EEEL520	Power system Transients	3	24EEPC201, 24EEPC401
5	24EEEL521	Energy conversion and storage techniques	3	24EEPC401
6	24EEEL522	Power plant Engineering	3	24EEPC401

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DOMAIN GROUP - II : ELECTRIC VEHICLES

S. NO	COURSE CODE	COURSE TITLE	CREDIT	PREREQUISITE COURSES
1	24EEEL510	Fundamentals of Thermal Management in EVs	3	24BSPH101, 24EEPC302, 24EEPC402
2	24EEEL511	Electrical Machine Design	3	24EEPC301, 24EEPC402
3	24EEEL523	Autonomous Vehicle system	3	24ESEE401
4	24EEEL524	Charging Infrastructure	3	24EEPC201, 24EEPC303, 24EEPC304
5	24EEEL525	Battery Technologies and Management Systems	3	24EEPC201
LABORATORY WITH THEORY				
6	24EEEP501	Special Electrical Machines Laboratory with Theory	3	24EEPC302,24EEPC402

DOMAIN GROUP - II : APPLIED ELECTRONICS

S. NO	COURSE CODE	COURSE TITLE	CREDIT	PREREQUISITE COURSES
1	24EEEL512	Micro Electro Mechanical Systems	3	24BSPH101, 24BSPH201
2	24EEEL513	Green Electronics	3	24BSCY201, 24EEPC304
3	24EEEL514	Digital Signal Processing	3	24BSMA201, 24ESEE401
4	24EEEL526	Consumer Electronics	3	24EEPC303
5	24EEEL527	Electromagnetic Interference and Electromagnetic Compatibility	3	24EEPC403
LABORATORY WITH THEORY				
6	24EEEP502	PCB design and Fabrication Laboratory with Theory	3	24BSPH201, 24EEPC201

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Electrical and Electronics Engineering

INDUSTRY CONNECTED PROFESSIONAL ELECTIVES
HCL BASKET

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24ECIE611	Embedded Systems	3	Embedded
2	24ECIE612	Object Oriented Programming For Embedded Systems	3	Embedded
3	24ECIE711	Advanced Embedded Programming	3	Embedded
4	24ECIE712	Product Development Process	3	Embedded
5	24ECIE713	Mini Project	4	Embedded
6	24ECIE811	Internship	3	Embedded
7	24ECIE812	Final Project	6	Embedded

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Electrical and Electronics Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Graduates will apply the principles of basic science, mathematics and engineering fundamentals necessary to formulate, solve and analyze engineering problems.

PEO2 Graduates will expertise in the field of Electrical and Electronics Engineering.

PEO3 Graduates will acquire the knowledge for pursuing advanced degrees in Engineering, Science, Management, Research and Development.

PEO4 Graduates will achieve professionalism, leadership qualities, self and continuous learning.

PEO5 Graduates will fulfill the needs of the society by working as Engineers, Entrepreneurs in core as well as inter-disciplinary areas in an ethical and responsible manner.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Students gain proficiency in analyzing and resolving complex issues related to Power and Energy, Power Electronics and Embedded Systems.

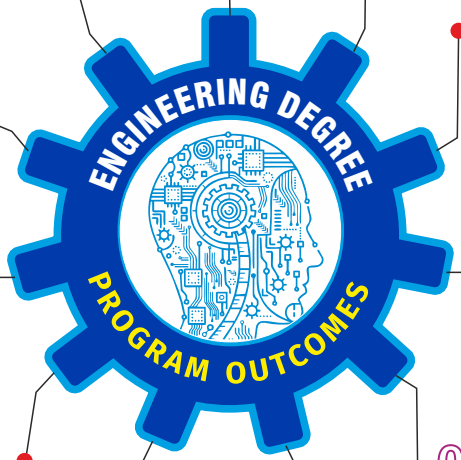
PSO 2: Students gain the knowledge to design and control electrical machines and drives for applications in transportation and industrial sectors.

COMPONENTS OF THE CURRICULUM (COC)

Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total Number of credits
Basic Sciences (BS)	18	32	30
Engineering Sciences (ES)	7	17	12
Humanities and Social Sciences (HS)	8	13	13
Professional Electives (EL)	12	20	20
Program Core + Program Lab (PC+PL)	31	62	52
Program theory with Lab (PW) / Program Lab With Theory (PT)	3	10	6
Open Elective (OE)	7	12	12
Training & Placement (TP)	2	14	4
Innovation & Development (ID) / Project (PJ)	10	32	16
Internships (IN)	2	9	3
Mandatory Courses (MC)	NA	4	NA
Total		**225**	**168**

PROGRAMME OUTCOMES(POs)

PROGRAM OUTCOME REPRESENTS THE KNOWLEDGE, SKILLS AND ATTITUDES THAT THE STUDENTS WOULD BE EXPECTED TO HAVE AT THE END OF THE 4 YEAR ENGINEERING DEGREE PROGRAM



01 Engineering knowledge
Apply math, science, computing, and engineering knowledge to solve complex engineering problems.

02 Problem Analysis
Identify and analyze complex problems using research to draw valid conclusions.

03 Design / Development of solutions
Design practical and innovative solutions considering safety, cost, culture, and the environment.

04 Investigate complex problems
Use research methods—experiments, modeling, and data analysis—to investigate complex problems.

05 Engineering Tool Usage
Apply modern engineering and IT tools for analysis and problem solving with awareness of their limits.

06 The Engineer and the World
Assess societal, environmental, legal, health, and cultural impacts of engineering solutions.

07 Ethics
Follow professional ethics, human values, diversity, inclusion, and legal responsibilities.

08 Individual & Teamwork
Work effectively as an individual and as a team member or leader in multidisciplinary groups.

09 Communication
Communicate clearly in writing and presentations for diverse technical and non-technical audiences.

10 Project Management and Finance
Apply management and financial principles to plan and execute projects effectively.

11 Life-long learning
Engage in independent lifelong learning and adapt to new technologies with critical thinking.

AUTONOMOUS CURRICULA AND SYLLABI
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SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	TOTAL CONTACT HOURS	CREDITS
THEORY							
1	24BSMA101	Matrices and Calculus	3	1	0	4	4
2	24HSEN101	Communicative English	3	0	0	3	3
3	24BSPH101	Engineering Physics	3	0	0	3	3
4	24BSCY101	Engineering Chemistry	3	0	0	3	3
5	24ESCS101	Problem Solving and Programming in C	3	0	0	3	3
6	24ESGE101	Engineering Graphics	1	2	0	3	3
7	24HSTA101	Heritage of Tamils	1	0	0	1	1
PRACTICALS							
1	24BSPL101	Physics and Chemistry Laboratory	0	0	4	4	2
2	24ESPL101	Programming in C Laboratory	0	0	2	2	1
VALUE ADDITIONS - I							
1	24ENTP101	Functional Life Skills	1	0	1	2	1
2	24ESID101	Idea Engineering Lab - I	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		Recommended by BoS					
				Total		30	25

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	TOTAL CONTACT HOURS	CREDITS
THEORY							
1	24BSMA202	Differential Equations, Complex Variables and Transforms	3	1	0	4	4
2	24HSEN201	Professional English	2	0	0	2	2
3	24BSPH201	Physics of Electronic Devices	3	0	0	3	3
4	24BSCY201	Chemistry for Environment and Sustainability	3	0	0	3	3
5	24EEPC201	Circuit Theory	2	1	0	3	3
6	24HSTA201	Tamils and Technology	1	0	0	1	1
7	24HSNC201	NCC Course Level 1*	2*	0	0	2*	0
PRACTICALS							
1	24ESGE102	Engineering Practices Laboratory	0	0	4	4	2
VALUE ADDITIONS - II							
1	24ENTP201	Digital Dynamics	0	0	2	2	0
2	24ESID201	Idea Engineering Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24[illegible]	MS Office (Mandatory - NC)	0	0	0	0	0
		*pply for NCC cadets		Total		24	19

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No. 8 Dated: 03.09.2024

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Electrical and Electronics Engineering

AUTONOMOUS CURRICULA AND SYLLABI
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SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	TOTAL CONTACT HOURS	CREDITS
THEORY							
1	24BSMA302	Linear Algebra and Partial Differential Equations	3	1	0	4	4
2	24EEPC301	Electromagnetic Fields	3	0	0	3	3
3	24EEPC302	Electrical Machines - I	3	0	0	3	3
4	24EEPC303	Analog Electronics	3	0	0	3	3
5	24EEPC304	Digital Electronics	3	0	0	3	3
6	24HSMC301	Universal Human Values - II Understanding Harmony	3	0	0	3	3
7	24HSNC301	NCC course Level 2*	3*	0	0	3*	0
PRACTICALS							
1	24EEPL301	Analog and Digital Electronics Laboratory	0	0	4	4	2
VALUE ADDITIONS - III							
1	24EETP301	Aptitude Skills - I	0	0	2	2	1
2	24EEID301	Innovative Design Lab - I	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24ESMC301	Joy of Computing using Python (Mandatory - NC)	0	2	0	2	0
				Total		29	23

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	TOTAL CONTACT HOURS	CREDITS
THEORY							
1	24BSMA403	Statistics and Numerical Methods	3	1	0	4	4
2	24EEPC401	Transmission and Distribution	3	0	0	3	3
3	24EEPC402	Electrical Machines - II	3	0	0	3	3
4	24EEPC403	Measurements and Instrumentation	3	0	0	3	3
5	24EIPC404	Control Systems	3	1	0	4	3
6	24MGOE9xx	Open Elective - I #	3	0	0	3	3
7	24HSNC401	NCC course Level 3*	3	0	0	3#	0
PRACTICALS							
1	24EEPL401	Control and Instrumentation Laboratory	0	0	4	4	2
2	24EEPL402	Electrical Machines Laboratory	0	0	4	4	2
VALUE ADDITIONS - IV							
1	24EETP401	Aptitude Skills - II	0	0	2	2	0
2	24EEID401	Innovative Design Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		Recommended by BoS		Total		32	24

*Only for NCC Cadets, to be conducted beyond working hours # Fundamentals of Supply Chain and Logistics Management

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No. 8 Dated: 03.09.2024

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Electrical and Electronics Engineering

SEMESTER - I

24BSMA101 - SDG NO. 4	MATRICES AND CALCULUS	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- To develop a strong foundation in matrix algebra and its applications.
- To introduce the concepts of limits, continuity, differentiation, and optimization for functions of several variables.
- To familiarize students with the principles of vector calculus relevant to engineering problems.
- To provide an understanding of double and triple integrals along with their practical applications.
- To impart knowledge of Fourier series and its significance in engineering analysis.

MODULE I MATRICES **12**

Eigenvalues and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem (excluding proof) – Symmetric and orthogonal matrices - Reduce the quadratic to canonical form using orthogonal transformation - Nature of quadratic forms.

MODULE II FUNCTIONS OF SEVERAL VARIABLES **12**

Limits, Continuity - Definitions - Partial derivatives - Taylor's series - Jacobians, Maxima and Minima - Method of Lagrange multipliers.

MODULE III VECTOR DIFFERENTIATION **4**

Scalar and vector valued functions - Gradient and directional derivatives – Tangent plane - Divergence and curl - Irrotational and solenoidal vector fields - Scalar and vector potentials - Vector identities (without proof).

MODULE IV VECTOR INTEGRATION **8**

Line integral over a plane curve - Surface integral - Area of a curved surface - Volume integral - Greens, Gauss divergence and Stoke's theorems - Verification and application in evaluating line, surface and volume integrals. (Cube and Cuboids).

MODULE V MULTIPLE INTEGRALS **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from cartesian to polar coordinates - Triple integrals – Volume of solids (Spherical and Cylindrical polar coordinates).

Recommended by Board of Studies of H&S dept. Meeting No. 6 Dated: 31/5/2024

Chairman
Board of Studies
Department of Humanities & Sciences

MODULE VI FOURIER SERIES **12**

Fourier series – Convergence of Fourier series - Half range sine and cosine series – Parseval's theorem.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Calculus and Analytic geometry, G.B. Thomas and R.L. Finney, 9th Edition, Pearson, Reprint, 2002.

REFERENCES:

1. Higher Engineering Mathematics, B. V. Ramana, 11th reprint, Tata McGraw-Hill, New Delhi, 2010.
2. Engineering Mathematics for first year, T. Veerarajan, Tata McGraw-Hill, New Delhi, 2008.
3. A text-book of Engineering Mathematics, N.P. Bali and Manish Goyal, 9th Edition, Laxmi Publications, Reprint, 2008.
4. Higher Engineering Mathematics, B. S. Grewal, 40th Edition, Khanna Publishers, New Delhi, 2007.

WEB REFERENCES:

1. https://testbook.com/maths/cayley-hamilton-theorem
2. https://www.iitg.ac.in/rafik/Tutorials/MA-102/2013/lect-10.pdf
3. https://ms.unimelb.edu.au/__data/assets/pdf_file/0007/2516596/functions_sev_var.pdf
4. https://www.mecmath.net/VectorCalculus.pdf
5. https://egyankosh.ac.in/bitstream/123456789/64855/1/Unit4.pdf
6. https://williamsgj.people.charleston.edu/Fourier%20Series.pdf

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=oJDlt_Xv-mM
2. https://www.youtube.com/watch?v=8h3yY0im5XU
3. https://www.youtube.com/watch?v=LGxE_yZYigI
4. https://www.youtube.com/watch?v=ma1QmE1SH3I
5. https://www.youtube.com/watch?v=QPw4GYz5Unc
6. https://www.youtube.com/watch?v=1mMYaPkXcNI

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Meeting No. 6 Dated: 31/5/2024

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COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

1. Diagonalize the matrix using orthogonal transformation and apply Cayley Hamilton Theorem to find the inverse and integral powers of a square matrix. (K3)
2. Evaluate the limit, examine the continuity and use derivatives to find extreme values for functions of several variables. (K3)
3. Compute the derivatives of scalar and vector point functions. (K3)
4. Use the vector point function to establish the relation between line, surface and volume integrals. (K3)
5. Apply double and triple integrals to find the area and the volume of a region. (K3)
6. Compute Fourier series expansion of a function. (K3)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-

SEMESTER - I

24HSEN101 - SDG NO. 4	COMMUNICATIVE ENGLISH	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- Develop the basic LSRW skills
- Acquire enhanced knowledge of English grammar
- Improve modern and technical vocabulary
- Enhance the communicative and cognitive skills
- Interpret the texts and write reviews critically

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Board of Studies of HES dept.
Meeting No. 6 Dated: 31/5/2024

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Department of Humanities & Sciences

MODULE - I COMMUNICATION PROCESS 8

Listening – informal conversations - Speaking – basics in speaking – speaking on given topics & situations – recording speeches and strategies to improve - Reading comprehension – skimming/ scanning/ predicting – question & answers – objective and descriptive answers - Writing – paragraph writing, personal notes - Language Development – parts of speech, prefix, suffix, word formation

MODULE - II LANGUAGE BARRIERS, LEVELS AND CHANNELS 8

Listening –interviews - Speaking – describing a simple process – asking and answering questions - Reading – critical reading – finding key information in a given text – ideation, mind mapping - Writing - dialogue,, instructions – Language Development – regular, irregular verbs, tenses, framing questions,

MODULE - III NARRATION AND SUMMATION 8

Listening - long texts - TED talks - extensive speech on current affairs - Speaking – role plays – asking about routine actions and expressing opinions - Reading- longer texts & making a critical analysis of the given text - Writing – essay (comparative / analytical), jumbled sentences, recommendations - Language Development – writing single sentence definitions, sequence words

MODULE - IV WRITING MECHANICS 7

Listening -debates and discussions – practicing multiple tasks –Speaking - self introduction about friends/ places/ hobbies - Reading -Making inference from the reading passage – Predicting the content of the reading passage - Writing – informal letters, e-mails - accuracy, coherence, brevity – Language Development- single word substitutes, compound words- conditionals

MODULE - V INTERPRETATION SKILLS 7

Listening- popular speeches and presentations - Speaking - impromptu speeches -Reading - articles – magazines - Writing – review writing, channel conversion – bar diagram/ table, poster/ picture interpretation - Language Development – modal verbs, collocations, 21st century vocabulary

MODULE - VI COGENT EXPOSITIONS 7

Listening - Motivational speeches - Speaking - Debates and discussion - Reading - analytical reading - newspapers - Writing - process description - Language Development - voices, sentences expressing purpose, synonyms & antonyms

TOTAL: 45 PERIODS

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Meeting No. 6 Dated: 31/5/2024

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Department of Humanities & Sciences

TEXT BOOKS:

1. Board of Editors. Using English: A Coursebook for Undergraduate Engineers and Technologists. Orient Blackswan Limited, Hyderabad: 2015.
2. A Course in Technical English, D. Praveen Sam and K.N. Shoba, Cambridge University Press, 2020

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader – Centered Approach. Cengage, New Delhi, 2008.
2. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason, USA, 2007.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford, 2007.
4. Chauhan, Gajendra Singh and et.al.Technical Communication (Latest Revised Edition). Cengage Learning India Pvt. Limited, 2018.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc19_hs31/preview
2. https://www.myenglishpages.com/speaking/#google_vignette

ONLINE RESOURCES:

1. https://wwPearson.com/english/catalogue/business-english/technical-english.html
2. https://ww.cambridgeenglish.org/learning-english/free-resources/

OUTCOMES:

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

1. Improve understanding and application of listening, speaking, reading, and writing skills (K2)
2. Demonstrate the ability to write personal notes, clear and coherent paragraphs (K2)
3. Apply analytical skills to write essays, rearrange jumbled sentences, and formulate recommendations (K3)
4. Apply skills to develop email etiquette and construct professional emails and informal letters (K3)
5. Analyze and interpret data to write comprehensive and effective reviews (K3)
6. Enhance vocabulary, improve grammatical accuracy, and confidently engage in debates (K2)

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Meeting No. 6 Dated: 31/5/2024

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CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	3	-	2	-	-
CO6	-	-	-	-	-	-	-	-	3	-	2	-	-

SEMESTER - I

24BSPH101 - SDG NO. 4,7,9,11	ENGINEERING PHYSICS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the basic concepts of mechanics and its use in engineering applications.
- To understand the concept of waves and lasers and its applications.
- To illustrate the various laws of electromagnetic waves and its applications.
- To apply the concepts of quantum mechanics to engineering studies.
- To understand the basics of crystal for engineering applications.
- To identify the basic principles involved in thermal physics and its applications.

MODULE - I PROPERTIES OF MATTER **8**

Elasticity – Hooke's law- Poisson's ratio - Stress - strain diagram and its uses - Twisting couple - shaft - Torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - I-shaped girders.

MODULE - II MECHANICAL WAVES AND LASERS **7**

Waves on a string – standing waves – traveling waves – Energy transfer of a wave – Reflection and refraction of light waves – interference –Theory of air wedge and experiment - Theory of laser – characteristics – Spontaneous and stimulated emission – Einstein's coefficients – population inversion – Nd-YAG laser, CO_2 laser – Basic applications of lasers in industry.

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Meeting No. 6 Dated: 31/5/2024

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MODULE - III ELECTROMAGNETIC WAVES 8

The Maxwell's equations – wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field – properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter – polarization – Producing electromagnetic waves – Energy and momentum in EM - Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

MODULE - IV BASIC AND APPLIED QUANTUM MECHANICS 7

Black body radiation – Planck's derivation – Electrons and matter waves –The Schrodinger equation (Time dependent and time independent forms) – significance of wave function – Normalization –Free particle – particle in a infinite potential well: 1D, 2D and 3D Boxes; - Barrier penetration and quantum tunneling (qualitative) – Scanning Tunneling Microscope.

MODULE - V CRYSTAL PHYSICS 8

Single crystalline, Polycrystalline and Amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal - Miller indices - Interplanar distance - X-Ray diffraction - Calculation of number of atoms per unit cell - Atomic radius - Coordination number – packing. factor for SC, BCC, FCC and HCP structures - Polymorphism and allotropy. Crystal Growth: Chochralski technique - Molecular beam epitaxy.

MODULE - VI THERMAL PHYSICS 7

Transfer of heat energy - Conduction, Convection and Radiation - Thermal conductivity, Forbe's method and Lee's disc method - Conduction through compound media - series and parallel methods - Heat exchangers - Refrigerators and Solar water heaters.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D.K. Bhattacharya & T.Poonam, "Engineering Physics". Oxford University Press, 2015.
2. R.K. Gaur & S.L. Gupta, "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. B.K. Pandey & S.Chaturvedi, "Engineering Physics", Cengage Learning India, 2017.
4. V. Rajendran, "Engineering Physics", Mc Graw Hill Publications Ltd. New Delhi, 2014.
5. M.N. Avadhanulu And P.G. Kshirsagar, "A textbook of Engineering Physics", S. Chand & Co Ltd. 2016.

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 31/5/2024

S. Narasakrishnan
Chairman
Board of Studies
Department of Humanities & Sciences

REFERENCES:

1. D. Halliday, Resnick & J. Walker, "Principles of Physics", Wiley, 2015.
2. R.A. Serway, & J.W. Jewett, "Physics for Scientists and Engineers", Cengage Learning, 2010.
3. N.K. Verma," Physics for Engineers", PHI Learning Private Limited, 2014.
4. P.A. Tipler & G. Mosca "Physics for Scientists and Engineers", W.H.Freeman, 2020.
5. Brijlal and Subramanyam, "Properties of Matter", S. Chand Publishing, 2018.
6. Shatendra Sharma & Jyotsna Sharma, "Engineering Physics", Pearson, 2018.
7. Arthur Beiser. "Concepts of Modern Physics", McGraw-Hill, 6th Edition. 2003.
8. Charles Kittel, "Introduction to Solid State Physics". John Wiely & Sons. 8th Edition, 2005.

OUTCOMES:

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

1. Apply the concepts of stress, torsion, and bending to study the mechanical behavior of structural elements using theoretical and experimental methods. (K3)
2. Analyze wave phenomena and interference to study energy transfer, and evaluate laser principles with their industrial applications. (K4)
3. Examine Maxwell's equations and electromagnetic wave theory to analyze wave propagation, polarization and reflection-transmission phenomena in different media (K4)
4. Utilize the principles of quantum mechanics to explain black body radiation, matter waves, particle confinement in potential wells and tunneling phenomena. (K3)
5. Examine and compare the characteristics of various crystal structures, polymorphic forms, and crystal growth techniques. (K4)
6. Apply the principles of heat transfer to determine the thermal conductivity and explain the role of heat exchangers in refrigerators and solar water heaters. (K3)

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CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-

SEMESTER - I

24BSCY101 - SDG NO. 4,7,8,9,11,12,17	ENGINEERING CHEMISTRY	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To enumerate the importance, synthesis, and applications of polymers.
- To impart basic knowledge of chemistry and the principles involved in electrochemistry, energy storage devices, and their commercial applications.
- To familiarize the fundamental laws and concepts of important photophysical and photochemical processes, as well as spectroscopy.
- To explore the fundamental concepts, laws, and principles of thermodynamics, and apply its derivations to optimize and innovate engineering processes across various disciplines.
- To comprehend the chemistry of fuels and combustion, and their applications across various engineering and industrial processes.
- To gain an understanding of the emergence and challenges of nanomaterials and nanotechnology across various scientific and technological disciplines.

MODULE - I POLYMER CHEMISTRY 8

Polymers: Definition, Degree of polymerization, Functionality of monomer, Classification of polymer with examples, Types of polymerization, Mechanism of addition polymerization (Free radical mechanism).

Plastics: Definition and Characteristics - Thermoplastics & Thermosets. Preparation, properties and engineering applications of plastics -PVC, Teflon, Kevlar and Bakelite.

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Fibers: Characteristics fibers - Preparation, properties and applications of Nylon and Dacron. Biodegradable polymers & Conducting Polymers: Characteristics, Classification and their applications.

MODULE - II ELECTROCHEMISTRY AND BATTERY TECHNOLOGY **7**

Electrochemistry: Types of Cells (Electrochemical and Electrolytic cell) – Redox reaction – Single and Standard electrode potential, Reference electrodes - SHE, Calomel electrode, Measurement of Single Electrode Potential, Nerns't equation (Derivation & Problems), Electrochemical series and its significance.

Batteries: Evolution of batteries – Primary and Secondary battery (Lead acid battery), Next Generation Battery Technology (NGBT) - Solid-state batteries (Lithium-ion), Sodium-ion batteries.

MODULE - III PHOTOCHEMISTRY & SPECTROSCOPY **7**

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency – determination-Photo processes - Jablonski diagram (Internal Conversion, Intersystem crossing, Fluorescence, Phosphorescence), Chemiluminescence and Photo-sensitization.

Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and Rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

MODULE - IV CHEMICAL THERMODYNAMICS **8**

Terminology of Thermodynamics - Laws of Thermodynamics – I law – Significance – Mathematical formulation and its applications. II law – Need for the II law. Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes, entropy of phase transitions; Clausius inequality. Helmholtz and Gibbs free energy functions, Criteria of spontaneity, Maxwell relations, Gibbs-Helmholtz equation, Van't Hoff Isotherm and Isochore.

MODULE - V FUELS **8**

Fuels: Introduction –Classification of fuels – Coal – Analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – manufacture of synthetic petrol (Bergius process). Knocking – Octane number and Cetane number – Gaseous fuels – Compressed natural gas (CNG), Liquefied petroleum gas (LPG). Biofuels – Gobar gas and Biodiesel.

Combustion of fuels: Introduction – Calorific value – Higher and Lower Calorific values. Theoretical calculation of Calorific value(Dulong formula) – Flue gas analysis (ORSAT Method).

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MODULE - VI NANOCHEMISTRY 7

Introduction - Types of nanomaterials - Emergence and challenges in nanotechnology- Synthesis routes for nanomaterials: Bottom-up and top-down approaches - Sol-gel, precipitation, Thermolysis, Laser ablation, Chemical Vapour Deposition (CVD), Electro deposition - Properties of nanomaterials- Mechanical properties, Chemical, Optical, Electrical and Magnetic properties-applications of nanomaterials (Gold nanoparticles as an example). Quantum Dots - concept, properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand &CompanyLTD, New Delhi, 2015.
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P)LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD,New Delhi, 2013.
4. Ravikrishnan A, 'Engineering Chemistry', Sri Krishna Hitech Publishing Company Pvt. Ltd, New Edition 2024.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi,2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
4. Chemistry of Nanomaterials Vol.1 S.S.R Kumar Challa (Ed).
5. Advanced chemistry by Phillip Matthews Vol.1 and Vol.2.
6. Chemistry in Engineering and Technology Vol. 1 & 2, J.C. Kuriacose and J. Rajaram.
7. Applied chemistry - A textbook for Engineers and Technologists by H.D. Gesser.

OUTCOMES:

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

1. Explain the importance of polymers in science and technology, describe their roles in different applications and discuss their impacts on modern advancements. (K3)
2. Recognize the basic principles of electrochemistry and describe their application in battery technologies. (K3)

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3. Apply the concepts of key photophysical and photochemical processes, as well as spectroscopy, to develop and optimize various applications. (K3)
4. Describe the principles of the second law of thermodynamics and its derivations to analyze engineering applications across all disciplines. (K3)
5. Categorize the chemistry of fuels and combustion and their applications at various levels. (K3)
6. Demonstrate the knowledge of nanomaterials, including their properties, behavior, interactions and applications across various disciplines of science and technology. (K3)

CO-PO, MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	-	-	2	-	-	-	-	-
CO2	3	3	3	-	-	2	-	-	-	-	-
CO3	3	2	3	-	2	-	-	-	-	-	-
CO4	3	2	3	-	-	1	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-
CO6	2	1	2	-	-	-	-	-	-	-	-

SEMESTER - I

24ESCS101 106105171 SDG NO. 4 & 9	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- Interpret Mathematical problems using algorithms, flowchart and pseudocode.
- To understand the programming language.
- To develop C Programs using basic Programming Constructs, Loops, Arrays and Strings.
- To develop applications in C using Functions, Pointers and Structures.
- To perform I/O operations and File Handling in C.

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Board of Studies of CSE dept.
Meeting No. 7 Dated: 30.5.24

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Sri Sairam Engineering College

MODULE - I INTRODUCTION TO PROGRAMMING AND ALGORITHMS FOR PROBLEM SOLVING 7

Introduction to Problem Solving through programs- Algorithm-Flowchart–Pseudocode-Memory, Variables, Values, Instructions, Programs-compilation process-Syntax and Semantic Errors- The language of C : Phases of developing a running computer program in C - Character set – Constants – Keywords – Primitive data types –Declaration, Type Conversion.

MODULE - II BASICS OF C PROGRAMMING 7

Sequential- Arithmetic Operators, Relational Operators, Logical Operators, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, selective – If, Else-If, Switch- repetitive structures-for, while, do while, Nested loops, go to, break, continue –Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD and LCM, Prime number generation.

MODULE - III ARRAYS AND STRINGS 8

Introduction to Arrays: Declaration, Initialization – One Dimensional Array – Example Program: Computing Mean, Median and Mode - Two Dimensional Arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String Operations: Length, Compare, Concatenate - Copy – Selection Sort - Linear and Binary Search.

MODULE - IV FUNCTIONS AND POINTERS 9

Introduction to Functions: Function Prototype, Function Definition, Function Call, Built-in Functions (String Functions, Math Functions) – Recursion – Example Program: Computation of Sine Series - Scientific Calculator using Built-in Functions - Binary Search using Recursive Functions - Factorial and Fibonacci Generation - Towers of Hanoi problem - – Pointers – Pointer Operators – Pointer Arithmetic – Arrays and Pointers –Array of Pointers – Example Program: Sorting of Names – Parameter Passing: Pass by Value - Pass by Reference – Example Program: Swapping of Two Numbers using Pass by Reference.

MODULE - V STRUCTURES 7

Structure - Nested Structures – Pointer and Structures – Array of Structures – Example Program using Structures and Pointers – Self Referential Structures – Dynamic Memory Allocation - Singly Linked List – Typedef.

MODULE - VI FILE PROCESSING 7

Files – Types of File Processing: Sequential Access, Random Access – Sequential Access File - Example Program: Finding Average of Numbers stored

Recommended by Board of Studies of CSE dept. Meeting No. 7 Dated: 30.5.24

CHAIRMAN Board of Studies Department of Computer Science and Engineering Sri Sairam Engineering College

in Sequential Access File - Random Access File - Example Program: Transaction Processing Using Random Access Files – Command Line Arguments.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.G. Dromey, "How to solve it by Computers", Reprint, PHI Publishers, 2011.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2018.
3. Kernighan, B.W and Ritchie D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

REFERENCES:

1. Yashwant Kanetkar, "Let us C", 18th Edition, BPB Publications, 2021.
2. Byron Gottfried, "Programming with C", Fourth Edition, Tata McGraw Hill Education, 2018.
3. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication, 2015.
4. Jeri R. Hanly & Elliot B.Koffman, "Problem Solving and Program Design in C", Pearson Education, 2013.
5. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
6. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
7. Hanly J R & Koffman E.B, "Problem Solving and Programme design in C", Pearson Education, 2009.

WEB REFERENCES:

1. https://www.learn-c.org/
2. https://codeforwin.org/
3. https://www.cprogramming.com

ONLINE RESOURCES:

1. https://www.linuxtopia.org/online_books/programing_books/gnu_c_programming_tutorial
2. https://nptel.ac.in/courses/106105171
3. https://swayam.gov.in/nd1_noc19_cs42/preview

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Sri Sairam Engineering College

OUTCOMES:

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

1. Solve basic problems using algorithms, flowcharts, and pseudo code.(K3)
2. Analyze the various programming constructs for basic computational problems.(K4)
3. Implement simple C programs using arrays and strings. (K3)
4. Use functions, recursion, and pointers to perform calculations, searching, and sorting.(K3)
5. Apply structures and dynamic memory allocation in handling complex programming tasks. (K3)
6. Organize sequential and random file processing techniques to provide solutions for real-world computational problems. (K4)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	-	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	1	2
CO4	-	3	-	-	-	-	-	-	-	-	-	2	2
CO5	-	3	-	-	-	-	-	-	-	-	-	2	3
CO6	-	-	3	-	-	-	-	-	-	-	-	3	3

SEMESTER - I

24ESGE101 - SDG NO. 4,6,7,9,12, 14 & 15	ENGINEERING GRAPHICS	L	T	P	CP	C
		1	2	0	3	3

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To visualize the job in three dimensions.
- To have a clear conception and appreciation of the shape, size, proportion and design.
- To expose the student community to existing national standards related to technical drawings.

Recommended by
Board of Studies of Mech. Engg dept.
Meeting No. 8 Dated: 1/6/2024

CHAIRMAN
Board of Studies
Mechanical Engineering

MODULE - I PLANE CURVES **6+4**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid on Horizontal Surfaces – Drawing of tangents and normal to the above curves.

MODULE - II PROJECTION OF POINTS, LINES AND PLANES **6+4**

Projection of Points (Concept only). Projection (Elevation and Plan) of straight lines, inclined to both reference planes by rotating line method. Projection of plane surfaces, inclined to one of the reference planes by rotating object method.

MODULE - III PROJECTION OF SOLIDS **6+4**

Projection of regular solids (Prisms, Pyramids, Cylinder and cone) in first quadrant, by rotating object method when the axis is inclined to one of the reference planes.

MODULE - IV ORTHOGRAPHIC PROJECTION **6+4**

Orthographic Projection - Principles of orthographic projections, Orthographic projection of objects from pictorial view.

MODULE - V SECTION AND DEVELOPMENT OF LATERAL SURFACE 6+4

Projection of sectioned solids (Prisms, Pyramids, Cylinder and cone) and true shape of the sections, when the axis of the solid is perpendicular to HP alone and cutting plane inclined to HP only. Development of lateral surfaces of sectioned regular vertical solids (Prisms, Pyramids, Cylinder and Cone) with cutting plane inclined to HP only.

MODULE - VI ISOMETRIC PROJECTIONS **6+4**

Isometric projection – Principle, isometric scale, Isometric views and Isometric projections of truncated solids - Prisms, Pyramids, Cylinder and Cone in simple vertical positions only.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.
2. T. Jeyapoovan, "Engineering Graphics using AUTOCAD", Vikas Publishing House Pvt Ltd, 7th Edition.

Recommended by
Board of Studies of Mech. Engg dept.
Meeting No. 8 Dated: 1/6/2024

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Board of Studies
Mechanical Engineering

REFERENCES:

1. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
3. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.

WEB REFERENCES:

1. https://archive.nptel.ac.in/courses/112/102/112102304/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/104/105104148/
2. https://nptel.ac.in/courses/112/103/112103019/

OUTCOMES:

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

1. Perform free hand drawing of conical sections and cycloids. (K3)
2. Sketch the orthographic projection of lines and plane surfaces of rectangle, square, pentagon and Hexagon. (K3)
3. Draw the orthographic projection of regular solids like prism, pyramids, cylinder and cone using change of position method. (K3)
4. Draw plan, elevation and side views for the 3dimensional isometric drawing by using the concepts of orthographic projection. (K3)
5. Draw the section and development of lateral surfaces for the regular solids like Prism, Pyramid, Cylinder and Cone for the axis perpendicular to HP. (K3)
6. Draw the isometric view, projection for regular and truncated solids like Prism, Pyramid, Cylinder and Cone. (K3)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	2	-	-	-	3
CO2	3	-	-	-	-	-	-	-	2	-	-	-	3
CO3	3	-	-	-	-	-	-	-	2	-	-	-	3
CO4	3	-	-	-	-	-	-	-	3	-	-	-	3
CO5	3	-	-	-	-	-	-	-	2	-	-	-	3
CO6	3	-	-	-	-	-	-	-	3	-	-	-	3

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Board of Studies of Mech. Eng. dept.
Meeting No. 8 Dated: 1/6/2024

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Mechanical Engineering

SEMESTER - I

24HSTA101 - SDG NO. 4	HERITAGE OF TAMILS	L	T	P	CP	C
		1	0	0	1	1

OBJECTIVES:

- Develop interest for classical language and literature to promote Tamil heritage
- Understand the ancient Tamil sculptures, folk and martial arts and contribution of Tamil to the freedom of India

அலகு ஐ மொழி மற்றும் இலக்கியம்

இந்திய மொழிக் குடும்பங்கள் — திராவிட மொழிகள் — தமிழ் ஒரு செம்மொழி — தமிழ் செவ்விலக்கியங்கள் — சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை — சங்க இலக்கியத்தில் பகிர்தல் அறம் — திருக்குறளில் மேலாண்மைக் கருத்துகள்

UNIT I LANGUAGE AND LITERATURE 5

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

அலகு II இடைகால மற்றும் நவீன இலக்கியங்கள்

தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம்- பக்தி இலக்கியம் — ஆழ்வார்கள் மற்றும் நாயன்மார்கள் — சிற்றிலக்கியங்கள் — தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி — தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

Unit II MEDIEVAL AND MODERN LITERATURE 5

Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

அலகு III மரபு ஓ பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை

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

UNIT III HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 5

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.

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அலகு IV நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

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

UNIT IV FOLK AND MARTIAL ARTS **5**

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

அலகு V தமிழர்களின் திணைக் கோட்பாடுகள்

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

UNIT V THINAI CONCEPT OF TAMILS **5**

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.

அலகு VI இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு — இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் — சுயமரியாதை இயக்கம் — இந்தியமருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு — கல்வெட்டுகள், கையெழுத்துப்படிகள் — தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

UNIT VI CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE **5**

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

TOTAL: 30 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு — மக்களும் பண்பாடும் — கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்)
2. கணினித் தமிழ் — முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி — வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை — ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

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6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian> Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - „Sangam ¡City Civilization on the þanks of river Vaigai... (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

OUTCOMES:

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

1. மொழிக் குடும்பங்களின் வரலாறு மற்றும் தமிழ் இலக்கியங்களை மதிப்பிடுகிறார்கள் Students evaluate the history of language families and Tamil literatures (K3)
2. பக்தி மரபுகளின் தாக்கம் பெற்ற தமிழ் இலக்கியங்களைப் புரிந்துகொள்கிறார்கள் Students understand Tamil literatures influenced by Philosophical and religious traditions (K3)
3. தமிழகத்தின் பாறை, சிற்பம், ஓவியம்- கலை மரபுகளைப் பகுப்பாய்வு செய்கிறார்கள் Students analyze the artistic traditions of Tamil Nadu such as rock art, sculpture, and painting (K3)
4. தமிழக நாட்டுப்புறக் கலைகள் மற்றும் தற்காப்புக் கலைகளின் மாண்புகளை உணர்ந்து கொள்கிறார்கள் Students realize the significance of Tamil Nadu's folk arts and martial arts (K3)
5. பழந்தமிழரின் திணையியல் வாழ்வியலை மீளாய்வு செய்கிறார்கள் Students re-examine the ecological lifestyle (Thinai-based life) of the ancient Tamils (K3)
6. தேசிய இயக்கம் மற்றும் இந்தியப் பண்பாட்டில் தமிழர்களின் பங்களிப்பினை நினைவுகூர்கிறார்கள் Students recall the contribution of Tamils to the National Movement and Indian culture (K3)

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Board of Studies of HSS **dept.**

Meeting No. 6 **Dated:** 31/5/2024

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Department of Humanities & Sciences

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	3	-	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	-	-	-	-	-	-	2	2	2
CO3	2	3	3	-	-	-	-	-	-	-	2	2	2
CO4	2	3	3	-	-	-	-	-	-	-	2	2	2
CO5	2	3	3	-	-	-	-	-	-	-	2	2	2
CO6	2	3	3	-	-	-	-	-	-	-	2	2	2

SEMESTER - I

24BSPL101 - SDG NO. 6,11,12,17	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	CP	C
		0	0	4	4	2

PHYSICS LABORATORY (Any Five Experiments to be conducted)

OBJECTIVES:

- Demonstrate the wave nature of light using diffraction and interference properties.
- Study the thermal conductivity of a bad conductor.
- Verify experimentally the elastic properties of materials.

Sl.No.	Name of the Experiment
1	(a) Determination of wavelength of Laser (b) Determination of numerical aperture and acceptance angle in an optical fiber. (c) Determination of particle size using laser source.
2	Determination of thermal conductivity of a bad conductor – Lee's Disc method
3	Determination of Young's modulus by non-uniform bending method

Recommended by Board of Studies of Physics dept. Meeting No. 6 Dated: 31/5/2024

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4	Determination of the period of oscillation of a given torsional pendulum for a fixed length and find the rigidity modulus of the wire.
5	Find out the thickness of the given wire by air wedge method.
6	Calculation of lattice cell parameter – X-ray diffraction method.
7	Determination of Planck's constant.
8	Determination of wavelength of mercury spectrum – spectrometer grating.
9	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
10	Determination of band gap of a semiconductor.
11	Determination of Hall coefficient by Hall Effect experiment.
12	Determination of solar cell characteristics.

CHEMISTRY LABORATORY (Any Five Experiments to be conducted)

OBJECTIVES:

- To acquaint students with practical knowledge of the basic concepts of chemistry that they will encounter during their studies and in the industry and engineering fields.
- To acquaint students with the determination of the molecular weight of a polymer by viscometry.
- To develop and understand the basic concepts of acidic and basic nature using pH.

Sl.No.	Name of the Experiment
1	Conductometric titration of strong acid vs strong base.
2	Determination of chloride content of water sample by Argentometric method.
3	Determination of strength of acids in a mixture of acids using conductivity meter.
4	Determination of total, temporary & permanent hardness of water by EDTA method.
5	Estimation of iron content of the given solution using potentiometer.
6	Determination of DO content of water sample by Winkler's method.
7	Determination of strength of given hydrochloric acid using pH meter.
8	Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method).

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 31/5/2024

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9	Estimation of Sodium and Potassium in the given sample of water using Flame Photometer.
10	Determination of molecular weights of polymer samples using Ostwald's Viscometer.
11	Synthesis of nano-CdS by precipitation. (Demonstration only)
12	Corrosion experiment-weight loss method.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Engineering Physics Lab, Dr. G. SenthilKumar, VRB publishers. (2019)
2. Engineering Physics Practical, Dr. P. Mani, Dhanam Publications. (2020)

TEXTBOOK:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th edition,2014).
2. Practical Physical chemistry by B. Viswanathan, P. S. Raghavan (Vivabooks), 2009.
3. Foundation of Experimental Chemistry by Jubaraj B. Baruah, Parikshit Gogoi, 2010.

OUTCOMES:

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

1. Apply the principles of elasticity and thermal physics to evaluate the various modulus of elasticity and conductivity of a bad conductor. (K3)
2. Explicate the properties of semi conductors by evaluating the band gap, I-V characteristics of solar cell and Hall effect of the materials. (K3)
3. Describe multiple measurement techniques, including volumetric titrations, conductivity, pH, redox potential and optical density measurements, used to estimate the amount of substance present in a solution. (K3)
4. Apply spectroscopic techniques, viscometry, synthesize nano particles, analyze the corrosion behaviour of materials in different environments. (K3)

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Meeting No. 6 Dated: 31/5/2024

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CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	2	-	-	-	-	-	2
CO2	3	3	-	-	2	-	-	-	-	-	2
CO3	3	3	-	-	2	-	-	-	-	-	2
Co4	3	3	-	-	2	-	-	-	-	-	2

SEMESTER - I

24ESPL101 - SDG NO. 4 & 9	PROGRAMMING IN CLABORATORY	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To develop programs in C using basic Programming Constructs.
- To develop applications in C using Arrays and Strings.
- To design and implement applications in C using Functions, Structures.
- To develop applications in C using Files.

LIST OF EXPERIMENTS

1. 1. Write a program using I/O statements and expressions.
2. Write programs using decision-making constructs.
3. Write a program to find whether the given year is a leap year or not? (Hint: not every century is a leap. For example 1700, 1800 and 1900 is not a leap year).
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Write a program to check whether a given number is an Armstrong number or not.
6. Write a program to check whether a given number is odd or even.
7. Write a program to find the factorial of a given number.
8. Write a program to find out the average of 4 integers.
9. Write a program to print half pyramid of *.
10. Write a program to display array elements using two dimensional arrays.
11. Write a program to perform swapping using a function.
12. Write a program to display all prime numbers between two intervals using functions.

Recommended by
Board of Studies of CSE dept.
Meeting No. 7 Dated: 30.5.24

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Sri Sairam Engineering College

13. Write a program to solve towers of Hanoi using recursion.
14. Write a program to get the largest element of an array using the function.
15. Write a program to concatenate two strings.
16. Write a program to find the length of String.
17. Write a program to find the frequency of a character in a string.
18. Write a program to store Student Information in Structure and Display it.
19. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:

(a) Total marks obtained by each student.
(b) The highest marks in each subject and the marks of the student who secured it.
(c) The student who obtained the highest total marks.

20. Write a program to demonstrate file operations (e.g. count the number of characters, words and lines in a file, replace a specific word with the given word in the same file).

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Stand alone desktops with C compiler 30 Nos. (Or)
   Server with C compiler supporting 30 terminals or more.

OUTCOMES:

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

1. Apply basic constructs,arrays,strings,functions and recursion for executing C programming applications.(K3)
2. Analyze C programs involving pointers and structures.(K4)
3. Evaluate applications using sequential and random access files.(K5)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	2	-	-	-	-	-	-	1	1
CO2	-	-	3	-	-	-	-	-	-	-	-	1	2
Co3	-	-	3	-	-	-	-	-	-	-	-	2	2

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Sri Sairam Engineering College

SEMESTER - I

24ENTP101 - SDG NO.4	FUNCTIONAL LIFE SKILLS	L	T	P	CP	C
		1	0	1	2	1

OBJECTIVES:

- Resolve common communication problems
- Observe the effectiveness of nonverbal messages
- Communicate precisely through the digital media
- Understand the importance of empathetic listening
- Explore reading and speaking processes

MODULE - I LISTENING 5

Techniques of effective listening
Listening and comprehending
Probing questions
Barriers to listening
Reflection from listening

MODULE - II SPEECH MECHANICS 5

Pronunciation
Enunciation
Vocabulary
Fluency
Common errors

MODULE - III READING SKILLS 5

Techniques of effective reading
Kinds of reading
Gathering ideas and information from the text
Evaluating the ideas and information
Interpreting the text from multiple angles

MODULE - IV WRITING ASPECTS 5

Writing process
Effective writing strategies
Different modes of writing
Optimizing the use of resources
Editing

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Meeting No. 6 Dated: 31/5/2024

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MODULE - V PRESENTATION SKILLS **5**

Types of presentations
Nonverbal communication
Understanding the purpose and the audience
Beginning and closure of presentations
Presentation tools and strategies

MODULE - VI ARTICULATION ASPECTS **5**

Perform exercises
Slow speeches
Long speeches
Monologues, Dialogues and Conversation
Feedback necessity

TOTAL : 30 PERIODS

REFERENCES:

1. Sen, Madhuchanda.2010, An Introduction to Critical Thinking, Delhi, Pearson.
2. Effective Communication Skills Strategies for Success. Edited by Nitin Bhatnager and Mamta Bhatnager. 2023, Pearson
3. Technical Communication: Principles and Practice, Meenakshi Raman and Sangeeta Sharma. Oxford University Press, 2015

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. https://www.myenglishpages.com/speaking/#google_vignette

OUTCOMES:

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

1. Employ reading, writing, and listening skills to communicate clearly in academic and professional contexts.
2. Demonstrate confident oral communication and presentation skills using appropriate tools and techniques.
3. Interpret ethical, inclusive, and culturally aware communication in team and societal settings

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CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-
CO3	-	-	-	-	-	-	-	3	2	-	2	-	-

SEMESTER - I

24ESID101 - SDG NO. 1-17	IDEA ENGINEERING LAB - I	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To understand the significance of Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) of the United Nations
- To familiarize with SDG targets and indicators
- To identify the Constitutional implementation pertaining to SDGs in Panchayat Raj
- To acquire knowledge of the State and the Central government welfare schemes
- To recognize the role of educational Institutions in community development
- To develop critical thinking skills to address complex societal challenges through an immersion program

MODULE - 1 United Nations Sustainability and the Sustainable Development Agenda 3

- Introduction to Sustainability
- Indian Rural Environment: Necessity and Sustainability
- Millennium Development Goals (MDGs)
- United Nations Sustainable Development Goals (SDGs) & the Agenda
- Overview of the Sustainable Development Goals (SDGs)

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MODULE - 2 Universal SDG Targets **4**

- SDG Framework
- Key Components
- Pillars of the SDGs
- Targets of the Goals
- Indicators of the Targets

MODULE-3 SDG and Indian Gram Panchayat **3**

- Gram Panchayat
- Salient Features of Constitutional Amendments
- Transition from SDGs to LSDGs (Localizing Sustainable Development Goals)

MODULE-4 Government Schemes **4**

- Introduction to State and Central Government Schemes
- Overview of Government Schemes
- Localization and Implementation at the Regional Level
- Impact on Local Communities

MODULE-5 Community Engagement **4**

- Key Recommendations of the National Education Policy
- Guidelines for Fostering Social Responsibility
- Awareness
- Participation
- Collaboration

MODULE-6 Idea Generation **12**

- Immersion Program
- Focus Areas
- Channelizing Ideas
- Forming Working Teams for SDGs (Sustainable Development Goals)

TOTAL: 30 PERIODS

REFERENCES:

1. Joy Elamon and Ms. Mariamma Sanu George,"The Handbook on Sustainable Development Goals and Gram Panchayats" , State Institute for Rural Development (SIRD).
2. Dr.C.R.Rene Robin, Dr.PA.Shanthi , Dr.B.Thanuja & Dr.V.Yuvaraj ,"Sairam SDG Idea Engineering Lab I", Sri Sairam Engineering College.

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WEB REFERENCES

1. UN Sustainable Development Goals
2. https://srmuniv.digimat.in/nptel/courses/video/109106200/L30.html
3. https://avcce.digimat.in/nptel/courses/video/109106200/L26.html

OUTCOMES:

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

1. Analyse and apply the concepts of sustainability,Rural environment,Gram panchayat and various government schemes to design innovative practical solutions that address real life rural challenges. (K2)
2. Compare MDG's,SDG's and LSDG's to analyse village topology and identify specific development targets to propose innovative rural solutions. (K4)
3. Analyse the attainment levels of SDG's and write a reflective report on local community.(K4)
4. Formulate problem statement based on local community needs and propose innovative ideas for community development. (K4)
5. Perform an individual presentation of field observation by mapping them with relevant SDG's and justify their significance for rural development. (K4)

CO-PO, PSO MAPPING:

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

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SEMESTER - II

24BSMA202 - SDG NO. 4	DIFFERENTIAL EQUATIONS, COMPLEX VARIABLES AND TRANSFORMS	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- The objective of this course is to familiarize the prospective engineers with techniques in Ordinary differential equations, Complex variables, Z-Transforms, Fourier Transforms and Laplace transforms. It aims to equip the students to deal with advanced levels of mathematics and applications that would be essential for their disciplines.

MODULE - I ORDINARY DIFFERENTIAL EQUATIONS **12**

Second and Higher order linear differential equations with constant coefficients - Method of variation of Parameters -Homogeneous equation of Euler's and Legendre's type - System of simultaneous first order linear differential equations with constant coefficients.

MODULE - II COMPLEX VARIABLES **9**

Analytic functions – Necessary and sufficient conditions for analyticity in cartesian and polar coordinates (without proof)- Properties- Harmonic Conjugate-Construction of analytic functions-Conformal mapping -Bilinear transformation ($w=1/z$).

MODULE - III COMPLEX INTEGRATION **9**

Cauchy- Goursat theorem (without proof) - Cauchy Integral formula (without proof) - Zeroes of Analytic functions - Singularities - Laurent's Series - Residues – Cauchy Residue theorem (without proof).

MODULE - IV LAPLACE TRANSFORMS **12**

Existence conditions – Transforms of elementary functions – Transform of Unit step function and Unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives – Transform of Periodic functions - Inverse Laplace Transforms - Initial and Final value theorems – Convolution theorem (excluding proof) –- Application of solution of linear second order ordinary differential equations with constant coefficients.

MODULE - V FOURIER TRANSFORMS **9**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Convolution theorem – Parseval's identity.

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MODULE - VI Z-TRANSFORMS 9

Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Advanced Modern Engineering Mathematics, Glyn James, 3rd Edition, Pearson Education, 2010.

REFERENCES:

1. Higher Engineering Mathematics, Dass, H.K., and Er. Rajnish Verma, S. Chand Private Ltd., 2011.
2. Higher Engineering Mathematics, B.S. Grewal, 44th Edition, Khanna Publishers, 2023.
3. Advanced Engineering Mathematics, Peter V. O'Neil, 7th Edition, Cengage learning, 2012.
4. An Introduction to Ordinary Differential Equations, E. A. Coddington, Prentice Hall, 1961.
5. Higher Engineering Mathematics, Ramana. B.V., 11th reprint, Tata McGraw-Hill, New Delhi, 2010.
6. A Textbook of Engineering Mathematics, N. P. Bali and Manish Goyal, Laxmi Publications, Reprint 2008.

WEB COURSES:

1. http://archive.nptel.ac.in/courses/111/106/111106100/
2. https://nptel.ac.in/courses/111105134/ (Week-3 Complex Differentiation)
3. https://nptel.ac.in/courses/111105134 (Week 4 Complex Integration)
4. https://archive.nptel.ac.in/courses/111/106/111106111/
5. http://www.nptelvideos.com/course.php?id=90

ONLINE RESOURCES:

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-1-introduction/
2. https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring-2018/

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COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

1. Solve ordinary differential equations of second and higher order with constant coefficients, variable coefficients and simultaneous linear differential equations. (K3)
2. Construct an analytic function and apply the properties of analytic functions to check for harmonic and orthogonal functions and find the images of circle and straight lines under the standard transformations. (K3)
3. Use Cauchy's integral theorem, formula and Cauchy's Residue theorem to evaluate complex and real integrals, find the Taylor's and Laurent's series expansion. (K3)
4. Apply Laplace and inverse Laplace Transforms to solve the linear ordinary differential equations with constant coefficients. (K3)
5. Find Fourier transforms and Fourier sine and cosine transforms of simple functions. (K3)
6. Solve difference equations using Z-transforms. (K3)

CO-PO, MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3	2
CO5	3	-	-	-	-	-	-	-	-	-	-	3	2
CO6	3	-	-	-	-	-	-	-	-	-	-	3	2

SEMESTER - II

24HSEN201 - SDG NO.4	PROFESSIONAL ENGLISH	L	T	P	CP	C
		2	0	0	2	2

OBJECTIVES:

- Acquire techniques for comprehending and critically analyzing passages
- Improve the communicative competence
- Enhance learners' ability to read and write complex texts, summaries, definitions and reports
- Write effective formal letters and reports

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- Develop skills for preparing effective job application

MODULE - I EFFECTIVE COMMUNICATION 6

Listening – Listening to conversations – Speaking – making conversations in real life occurrences – Reading - short stories, happenings - Writing – autobiographical writing, preparation of checklist – communication and types of communication – Language Development -- subject - verb agreement, commonly confused words – spellings

MODULE - II BASICS OF TECHNICAL WRITING 5

Listening – listening to advertisements and products – Speaking - creating greetings/wishes/excuses and thanks – Reading – articles/novels - Writing - summary of articles, writing modes, formats, compositions - Language Development - reported speech, numerical adjectives

MODULE - III REPORT WRITING 4

Listening – listening to podcasts – Speaking - practicing telephonic conversations – observing and responding. Reading – regular columns of newspapers/magazines - Writing – reports – feasibility, accident, preparation of agenda and minutes – Language Development - cause & effect expressions, discourse markers

MODULE - IV DIVERSE WRITING SKILLS 5

Listening – documentaries, anecdotes and short stories - Speaking – expressing opinions using verbal and non-verbal communication – Reading biographies/autobiographies, travelog, – Writing – formal letters – inviting guests – acceptance/declining letters - Language Development- degrees of comparison – embedded sentences - acronyms and abbreviations

MODULE - V CAREER COMPETENCIES 6

Listening – expert talks – recommending suggestions & solutions – Speaking – Debate- participating in a group discussion – learning GD strategies – Reading – innovations, ideations - Writing – Job application, resume, – proposals – Language Development – verbal analogies – phrasal verbs

MODULE - VI LEXICAL ENHANCEMENT 4

Listening - technical and general talks - Speaking - oral presentation with visual aids - Reading - successful stories/autobiographies - Writing - writing blogs - Language Development - common errors in English, idiomatic expressions

TOTAL: 30 PERIODS

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TEXT BOOKS:

1. Board of editors. Fluency in English: A Course book for Engineering and Technology. Orient Blackswan, Hyderabad 2016.
2. Raman, Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford University Press.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. Routledge, New York,2011.
2. Raman, Meenakshi, Sharma, Sangeeta. Technical Communication. Principles and Practice. Oxford University Press, New Delhi, 2014.
3. Muralikrishnan & Mishra Sunitha, Communication skills for Engineers 2nd ed. Pearson, Tamil Nadu, India 2011. P. Kiranmai and Rajeevan, Geetha. Basic Communication Skills, Foundation Books, New Delhi, 2013.
4. Vesilind Aarne P., Public Speaking and Writing Skills for Engineering Students (2nd Ed), Lakeshore press, 2007
5. Richards, Jack C. Interchange Students' Book – 2. Cambridge University Press, New Delhi, 2015.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_hs21/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109106122/lec1.pdf
3. https://takelessons.com/en-in/search?service=English&sort=1&utm_

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/improve-english?
2. https://www.fluentu.com/blog/educator-english/business-english-conversation-topics/

OUTCOMES:

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

1. Demonstrate an understanding of various types of communication and prepare effective checklists.(K2)
2. Summarize articles/ write ups (K2)
3. Construct feasibility reports, accident reports, survey reports and meeting minutes (K3)
4. Apply skills to compose official letters with emphasis and clarity (K3)
5. Compose job applications and technical proposals (K3)

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6. Demonstrate the ability to express opinions in both oral and written forms of communication (K2)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	1	3	-	3	-	-
CO6	-	-	-	-	-	-	-	1	3	-	3	-	-

SEMESTER - II

24BSPH201 - SDG NO. 4,7,9	PHYSICS OF ELECTRONIC DEVICES	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To acquaint the electrical properties of materials.
- To enlighten the basic principles of semiconductor physics.
- To acquaint the applications of semiconductor devices.
- To introduce the optical properties of materials.
- To educate the properties of magnetic and dielectric materials and their uses.
- To illustrate the properties and applications of nano devices.

MODULE - I ELECTRICAL PROPERTIES OF MATERIALS **8**

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 – tight binding approximation - Electron effective mass- concept of hole.

MODULE - II SEMICONDUCTOR AND TRANSPORT PHYSICS **7**

Semiconductors – Energy band diagram – direct and indirect band gap semiconductors –Intrinsic semiconductor– Carrier concentration in intrinsic

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semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors:, Mobility ,Drift and Diffusion Current densities.

MODULE - III SEMICONDUCTOR SWITCHING DEVICES **8**

PN Junction Diode - Construction ,Working and Characteristics - Transistor - NPN, PNP working - Early effect - Current equations - Input and Output Characteristics of CB, CE and CC configurations - JFET and its characteristics - MOSFET and its characteristics - Construction and Working of D-MOSFET - UJT, SCR - CCD and Optocoupler. IoT concept and use in industry.

MODULE - IV OPTICAL PROPERTIES OF MATERIALS **7**

Classification of optical materials - optical absorption and emission process in materials - charge carrier generation and recombination - optical absorption loss and gain.– Optoelectronic devices - Solar cells – LED – OLED - Nonlinear optics- Modulators, switching devices Plasmonics (Qualitative)

MODULE - V MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS8

Magnetism in materials - Magnetic field and induction - Magnetization - permeability and susceptibility - Types of magnetic materials - microscopic classification of magnetic materials Ferromagnetism - Domain Theory - Hysteresis phenomenon - Dielectric materials – Introduction - Types of Polarization (qualitative) - internal field - Clausius-Mossotti relation – dielectric loss - dielectric breakdown (definitions) - Dielectric constant measurement by Schering bridge method.

MODULE - VI NANO DEVICES **7**

Quantum Confinement - Quantum structures - Density of states in quantum well, wires, and dots (Quantitative) - Band Gap of Nano materials - Tunnelling - Single electron phenomena - Single electron transistor - Quantum DOT lasers - Conductivity of metallic nano wires - Carbon Nano Tubes (CNT): Structures, properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
2. R.F.Pierret. Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.
3. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.
4. Dr.P.Mani. Physics for Electronic Devices, Dhanam Publications, 2024.

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REFERENCES:

1. Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., 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. Mark Fox, Optical Properties of Solids, Oxford Univ.Press, 2001.
4. N.Gershenfeld. The Physics of Information Technology. Cambridge University Press, 2011.

OUTCOMES:

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

1. Explore the basic concepts of free electron theory of solids and apply it to determine the conducting properties, carrier concentration and effective mass of an electron in conductors (K3)
2. Analyze the band structures and carrier concentrations of semiconductors, study their variations with temperature, and examine carrier transport mechanisms (K4)
3. Apply the working principles of semiconductor devices and use IoT concepts in practical applications (K3)
4. Examine the optical processes in materials and analyze the operation of optoelectronic devices (K4)
5. Demonstrate the magnetic and dielectric properties of materials and their applications (K3)
6. Analyze quantum confinement and quantum structures, examine the working principles of quantum devices, and explore the applications of carbon nanotubes (K4)

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-
CO6	-	3	-	-	-	-	-	-	-	-	-

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SEMESTER - II

24BSCY201 - SDG NO.4	CHEMISTRY FOR ENVIRONMENT AND SUSTAINABILITY	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To gain a comprehensive understanding of environmental science, the intricate relationships within ecosystems, and the crucial role of biodiversity conservation..
- To introduce the structure and components of the atmosphere, and provide an overview of the photochemical reactions involved.
- To foster a sound understanding of water quality parameters and water treatment techniques.
- To explore the various components of soil and understand the steps involved in Solid Waste Management (SWM).
- To advocate the benefits of renewable energy and promote awareness of sustainable energy practices..
- To implement the principles of Green Chemistry in alignment with the Sustainable Development Goals (SDGs).

MODULE - I INTRODUCTION TO ENVIRONMENTAL SCIENCE **8**

Environment: Definition, concept of environment and its components - scope and importance of environment – need for public awareness.

Ecosystem: Structure and functions: Structures - Biotic and Abiotic components. Functions - Energy flow in ecosystems, food chains and food webs. Biogeochemical cycles(C,N&P), Ecological succession.

Biodiversity and its conservation: Definition, types, importance of biodiversity, values and threats to biodiversity. Endangered and endemic species - concept and basis of identification of 'Hotspots'; hotspots in India. Strategies for biodiversity conservation: in situ, ex situ and in vitro conservation.

MODULE - II ATMOSPHERIC CHEMISTRY **7**

Atmospheric Chemistry - Composition and structure of atmosphere. Climate change - greenhouse effect - role of greenhouse gases (CO2, CH4, N2O, CFCs) on global warming. Chemical and photochemical reactions in the atmosphere - Formation of smog, PAN, acid rain (causes, effect and control measures). Oxygen and ozone chemistry - Ozone layer depletion (causes, effect and control measures).

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MODULE - III WATER CHEMISTRY **8**

Importance and scope of water chemistry - Sources and impurities in water - Water Quality Parameters - Specifications as per WHO/BIS standards. Hardness of water, types, numerical problems on hardness of water. Softening of water - Internal treatment (Lime-soda, Phosphate, Calgon, Sodium Aluminate and Colloidal conditioning). External treatments: Ion exchange and Zeolite processes. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water by Reverse osmosis. Sustainable water management practices (water recycling and rainwater harvesting)

MODULE - IV SOIL CHEMISTRY AND SOLID WASTE MANAGEMENT **7**

Soil Chemistry: Chemical composition of soil, Acid-Base and Ion-Exchange Reactions in Soil, Soil acidity and salinity. Importance of NPK in Soil Fertility. Modern agriculture - Impacts of both excessive and insufficient fertilizer use, alongside the effects of pesticides on soil chemistry and the environment. Sustainable agriculture - Approaches to improve soil salinity (leaching, soil amendments, crop rotation), Design and use of green pesticides for sustainable farming.

Solid Waste Management System: Sources and types of solid waste, Elements of solid waste management, Methods of residential and commercial waste collection, Treatment / processing - Incineration, Composting, Landfill - Dumpsite rehabilitation.

MODULE - V ENERGY AND ENVIRONMENT **8**

Energy sources – Renewable and non-renewable energy sources. Principle and generation of solar energy (solar collectors, photo-voltaic modules, solar ponds), wind energy, geothermal energy; tidal energy, OTEC energy from biomass, biofuels, Nuclear energy - fission and fusion, Nuclear fuels, Nuclear reactor – principles and types. Need for energy efficiency, Energy conservation and sustainability - action strategies for sustainable energy management from a future perspective.

MODULE - VI GREEN CHEMISTRY AND SUSTAINABILITY **7**

Green Chemistry: Introduction to green chemistry, Principles of Green Chemistry (12-principles), the concept of atom economy and chemical synthesis, Important techniques used in green chemistry. Application of green chemistry, viz. replacement of ozone depleting substances including CFCs, manufacture of biodegradable polymers, use of H_2O_2 as benign bleaching agents in the paper industry.

Sustainable Development: Definition and concepts of sustainable development, Need for sustainable development; Sustainable development

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goals – 17 SDG goals.

Sustainable practices: Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment and Environmental Impact Assessment.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
3. Ravikrishnan A, 'Environmental Science and Engineering', Sri Krishna Hitech Publishing Company Pvt. Ltd, Revised Edition 2020.
4. Vogel's Textbook of Quantitative Chemical Analysis (8th edition,2014).

REFERENCES:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hyderabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
4. Chemistry for Environmental Engineering, Clair N. Sawyer, Perry L. Mc Carty, Gene F. Parkin, 4th Edition, McGraw-Hill.

OUTCOMES:

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

1. Develop a foundational understanding of environmental science, the interactions within ecosystems, the significance of biodiversity, and the importance of conservation strategies for maintaining ecological balance. (K3)
2. Identify the primary components of the atmosphere, explain the causes of atmospheric pollution, and propose basic strategies to promote a sustainable and clean atmosphere. (K3)
3. Demonstrate complex water quality parameters, and develop innovative methods for producing cost-effective soft water suitable for both industrial use and potable consumption. (K3)
4. Describe the composition and functions of soil components, analyze the sources and characteristics of solid wastes, and evaluate the methods and strategies employed in solid waste management (SWM). (K3)

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5. Explain renewable and non-renewable resources, describe various methods for harnessing energy from different sources and explain their applications in various contexts. (K3)
6. Illustrate a comprehensive understanding of green chemistry principles and their alignment with sustainable development goals, preparing them to contribute to environmentally friendly and sustainable practices in their future careers.(K3)

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-
CO6	3	3	-	2	1	-	-	-	-	-	-

SEMESTER - II

24EEPC201 108105159 SDG NO. 4 & 9	CIRCUIT THEORY	L	T	P	CP	C
		2	1	0	3	3

OBJECTIVES:

- To utilize the concepts of basic laws for solving DC circuits.
- To apply the fundamentals of AC circuits to solve mesh current and node voltage method.
- To apply Network theorems to simplify for both DC and AC circuits
- To solve the Transient response of circuits for RL, RC and RLC circuits with DC and AC input.
- To develop the Frequency response for resonance circuits, single tuned circuits.
- To develop the performance parameters of three phase systems and power measurement.

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MODULE - I BASIC DC CIRCUITS ANALYSIS **7**

Resistive elements - Ohm's law Resistors in series and parallel circuits – Kirchoff's law- Network reduction-Voltage and current division, source transformation – Star Delta conversion - Mesh current and node voltage methods for DC circuits.

MODULE - II FUNDAMENTALS OF AC CIRCUITS ANALYSIS **7**

AC Fundamentals- Average and RMS value - Phasor diagram – Power, Power factor and energy – Mesh current and node voltage methods for AC circuits.

MODULE - III NETWORK THEOREMS FOR DC AND AC CIRCUITS **7**

Superposition theorem - Thevenin's and Norton's theorems – Maximum power transfer theorem.

MODULE - IV TRANSIENT RESPONSE ANALYSIS **8**

R, L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and AC sinusoidal input.

MODULE - V RESONANCE AND COUPLED CIRCUITS **8**

Series and parallel resonance–Frequency response – Quality factor and bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

MODULE - VI THREE PHASE CIRCUITS **8**

Three phase 3-wire and 4-wire circuits - Star and delta connection for balanced and un balanced loads– Phasor diagram of voltages and currents – Power and power factor measurement in three phase circuits.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw Hill, Fifth Edition, 2015.
2. Charles K.Alexander, Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Sixth Edition, McGraw Hill, 2022.
3. Joseph A.Edminister, Mahmood Nahri, "Electric circuits", (Schaum's outline series), Mc Graw- Hill, New Delhi, Fifth edition, 2010.

REFERENCES:

1. Chakrabarti A, "Circuits Theory Analysis and Synthesis", Dhanpath Rai & Sons, New Delhi, Seventh edition, 2023.

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2. A Nagoor kani, "Circuit Analysis," McGraw Hill, First edition, 2018
3. William H. Hayt, Jack Kemmerly, Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill, ninth edition, 2020.
4. Mahadevan K ,Chitra C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd., New Delhi, Second edition, 2018.
5. Richard C. Dorf and James A.Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc., 9th edition, 2015.

WEB RESOURCES:

1. https://www.edx.org/learn/circuits/massachusetts-institute-of-technology-circuits-and- electronics-1-basic-circuit-analysis
2. https://www.circuit-magic.com/
3. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/108/102/108102097/
2. https://archive.nptel.ac.in/courses/108/105/108105159/
3. https://onlinecourses.nptel.ac.in/noc22_ee90/preview

OUTCOMES:

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

1. Apply Ohm's law, Kirchhoff's laws, star-delta conversion, mesh current and node voltage methods in DC circuits. (K3)
2. Apply basic AC fundamentals and mesh and nodal techniques in AC circuits. (K3)
3. Make use of Superposition, Thevenin's, Norton's and Maximum power transfer theorems for network reduction of DC and AC circuits. (K3)
4. Solve the transient response of RL, RC, RLC circuits using Laplace transforms for DC and AC inputs. (K3)
5. Develop the frequency response of series and parallel resonance circuits and single tuned circuits. (K3)
6. Develop the performance parameters of three phase three wire and four wire circuits for various conditions. (K3)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO4	3	3	2	-	-	-	-	-	-	-	-	2	2
CO5	3	3	2	-	-	-	-	-	-	-	-	2	2
CO6	3	3	2	-	-	-	-	-	-	-	-	2	2

SEMESTER - II

24HSTA201 - SDG NO. 4	TAMILS AND TECHNOLOGY	L	T	P	CP	C
		1	0	0	1	1

OBJECTIVES:

- Understand the techniques that help for a better livelihood
- Identify the methods used for scientific Tamil computing

அலகு-I நெசவு மற்றும் பானைத் தொழில்நுட்பம்

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

UNIT-I WEAVING AND POTTERY (CERAMIC) TECHNOLOGY 5

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

அலகு -II சங்ககாலவடிவமைப்புகள்

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள்ரூசங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு -சங்க காலத்தில் கட்டுமான பொருட்களும்நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள்.

UNIT-II SANGAM AGE DESIGNS 5

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

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அலகு -III பழங்காலகட்டிடத் தொழில்நுட்பம்

மாமல்லபுரச்சிற்பங்களும், கோவில்களும் - சோழர்காலத்துப்பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத்தலங்கள் - நாயக்கர்காலக்கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டுவீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக்கட்டிடக் கலை.

UNIT-III ANCIENT CONSTRUCTION TECHNOLOGY **5**

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.

அலகு- IV உற்பத்தித் தொழில்நுட்பம்

கப்பல் கட்டும் கலை -உலோகவியல் -இரும்புத் தொழிற்சாலை இரும்பை உருக்குதல், எஃகு - வரலாற்றுச்சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் சங்கு மணிகள் -எலும்புத்துண்டுகள் - தொல்லியல்சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

UNIT-IV MANUFACTURING TECHNOLOGY **5**

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 beads - Archaeological evidences - Gem stone types described in Silappathikaram.

அலகு - V வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக்குமுழித்தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காகவடிவமைக்கப்பட்டகிணறுகள்- வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள்- கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

UNIT-V AGRICULTURE AND IRRIGATION TECHNOLOGY **5**

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

அலகு-VI அறிவியல்தமிழ்மற்றும்கணித்தமிழ்

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

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UNIT-VI SCIENTIFIC TAMIL & TAMIL COMPUTING 5

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

TOTAL: 30 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு — மக்களும் பண்பாடும் — கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்)
2. கணினித் தமிழ் — முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி — வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை — ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian> Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - „Sangam City Civilization on the banks of river Vaigai... (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

OUTCOMES:

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

1. சங்ககால நெசவு மற்றும் பானைத்தொழில்நுட்பங்களைப் பற்றி அறிந்து கொள்ளுதல்
   To learn about the weaving and pottery (ceramic) technologies during the Sangam Age.(K2)
2. சங்ககாலவடிவமைப்புகள் மற்றும் கட்டுமானக்கலையைப் புரிந்து கொள்ளுதல்
   To understand the designs and structural constructions during the Sangam period.(K2)
3. பண்டைய கால கட்டிடக்கலையின்நுட்பங்கள் மற்றும் கட்டிடவடிவமைப்புகளை ஆராய்தல்.
   To explore the techniques and architectural patterns of ancient Tamil structures.(K2)
4. உற்பத்தி மற்றும் உலோகவியல்தொழில்நுட்பங்களைப் பற்றி அறிதல்.

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To gain knowledge on manufacturing and metallurgical technologies of ancient Tamils.(K3)

5. வேளாண்மை, நீர்ப்பாசனம் மற்றும் கடல்சார்தொழில்நுட்பங்களைப் பற்றி அறிந்து கொள்ளுதல்.
To understand agricultural> irrigation> and marine technologies of ancient Tamil society.(K3)

6. அறிவியல்தமிழ் மற்றும் கணித்தமிழின்வளர்ச்சியையும் அதன் கணினி பயன்பாடுகளையும் புரிந்து கொள்ளுதல்.
To understand the development of Scientific Tamil and its applications in Tamil computing.(K3)

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	1	2	2
CO2	3	3	3	2	-	-	-	-	-	-	1	2	1
CO3	3	3	3	3	-	-	-	-	-	-	1	2	1
CO4	3	2	3	3	-	-	-	-	-	-	1	2	2
CO5	3	3	3	3	-	-	-	-	-	-	1	2	1
CO6	3	3	3	3	-	-	-	-	-	-	1	2	2

SEMESTER - II

24HSNC201 - SDG NO. 4	NCC COURSE LEVEL 1	L	T	P	CP	C
		2	0	0	2	0

ARMY WING

NCC GENERAL **6**

NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

NATIONAL INTEGRATION AND AWARENESS **4**

NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1

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PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
		TOTAL: 30 PERIODS

NAVAL WING

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2

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LEADERSHIP **5**

L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT **8**

SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL: 30 PERIODS

ARMY WING

NCC GENERAL **6**

NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

NATIONAL INTEGRATION AND AWARENESS **4**

NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1

PERSONALITY DEVELOPMENT **7**

PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2

LEADERSHIP **5**

L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT **8**

SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3

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SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	TOTAL: 30 PERIODS	

SEMESTER - II

24ESGE102 - SDG NO. 4,9,12	ENGINEERING PRACTICES LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To provide exposure to the students with hands-on experience on various basic engineering practices in Electrical and Electronics Engineering, Civil and Mechanical Engineering.

ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp, and energy meter.
2. Fluorescent lamp wiring.
3. Staircase wiring.

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4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipment – Resistor- colour coding, measurement of AC signal parameter (peak-peak RMS, period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR, and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices, and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of Half Wave Rectifier and Full Wave Rectifier.
6. Simulation of Half Wave Rectifier and Full Wave Rectifier using TinkerCAD.

CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings, safety aspects.

Plumbing Works:

1. Study of pipeline joints, its location and functions: valves, taps, couplings,unions, reducers, elbows in household fittings.
2. Study of pipe connections requirements for pumps and turbines.
3. Preparation of plumbing line sketches for water supply and sewage works.
4. Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
5. Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

MECHANICAL ENGINEERING PRACTICE

Welding:

1. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
2. Gas welding demo practice.

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Basic Machining:

1. Simple Turning and Taper turning.
2. Drilling Practice.

Sheet Metal Work:

1. Forming & Bending.
2. Model making – Trays and funnels.
3. Different type of joints.

Demonstration on:

1. Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
2. Foundry operations like mould preparation for gear and step cone pulley.
3. Fitting – Exercises – Preparation of square fitting and V – fitting models.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items:	
Iron box, fan and regulator, emergency lamp	1 Each
4. Megger (250V/500V)	1 No
5. Power Tools:	
Range Finder	2 Nos
Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos
2. Assorted electronic components for making circuits	50 Nos
3. Small PCBs	10 Nos
4. Multimeters	40 Nos

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets

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2. Carpentry vice (fitted to work bench).	15 Nos
3. Standard woodworking tools.	15 Sets
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools:	
Rotary Hammer	2 Nos
Demolition Hammer	2 Nos
Circular Saw	2 Nos
Planner	2 Nos
Hand Drilling Machine	2 Nos
Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos
2. Arc welding transformer with cables and holders	5 Nos
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5. Centre lathe.	2 Nos
6. Hearth furnace, anvil and smithy tools.	2 Sets
7. Moulding table, foundry tools.	2 Sets
8. Power Tool: Angle Grinder.	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner.	1 each

OUTCOMES:

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

1. Infer the values of resistance, peak to peak RMS values, time period, frequency. [K2]
2. Outline the logic gates, rectifier, timer circuits and soldering practices. [K2]
3. Demonstrate the measurement of electrical parameters such as voltage, current, resistance, power and energy. (K2)
4. Illustrate the residential wiring, staircase wiring and fluorescent lamp wiring.[K2]
5. Prepare the carpentry and plumbing joints. (K2)
6. Perform the basic operations of welding, sheet metal work and basic machining operations in Lathe and Drilling (K2)

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CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	-		-	-	-	-	-	-	-	-	2	2
CO5	2	-	-	-	-	-	-	-	-	-	-	2	2
CO6	2	-	-	-	-	-	-	-	-	-	-	2	2

SEMESTER - II

24ENTP201 - SDG NO. 4	DIGITAL DYNAMICS	L	T	P	CP	C
		1	0	1	2	0

OBJECTIVES:

- Explore online communication
- Master computer skills
- Use virtual platforms
- Understand digital ethics and cyber security
- Observe and follow do's and don'ts

MODULE - I DIGITAL CULTURE AND SOCIETY **6**

Adapting to changes
Importance in today's digital landscape
Digital identity and self- presentation
Online communities and forums
Digital divide and consequences
Online collaboration and collective action

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MODULE - II DIGITAL LITERACY AND ACCESS TO TECHNOLOGY **5**

Computer skills
Social and cultural understanding
Social media campaign and Activism
Netiquettes
Trending Technologies
Digital tools and softwares

MODULE - III DIGITAL ETHICS **3**

Digital ethics and moral panics
The art of protecting secrets
Overview of digital tools

MODULE - IV CYBER SECURITY **3**

Threats, vulnerability and consequences
Data making and usage practice
Importance of security

MODULE - V DIGITAL NETWORKING **7**

Remote work and virtual teams
Authenticity in digital interactions
Engaging content creation
Tools and and techniques for insightful usage
Balancing online and offline interactions
Collaboration for research and innovation

MODULE - VI BUREAU OF INDIAN STANDARDS (BIS): BASIC CONCEPTS, STANDARDS FORMATION PROCESS AND CHALLENGES **6**

Standardization –Basic Concepts:

Basic concepts of standardization

Purpose of standardization, marking and certification of articles and processes

Importance of standards to industry, policy makers, trade, sustainability and innovation

Standards Formulation Process and Challenges:

Objectives, roles and functions of BIS, Bureau of Indian Standards Act, ISO/ IEC Directives

WTO Good Practices for Standardization

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World of Standards:
Important Indian and International Standards

TOTAL: 30 PERIODS

REFERENCES:

1. Communication Skills and Soft Skills – an Integrated Approach. Edited by E. Sureshkumar, P. Sreehari and J. Savithri, Pearson.
2. Silvia. P.J.2007. How to Read a Lot. Washington DC, American Psychological Association.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. https://www.sscnasscom.com/ssc-projects/capacity-building-and-development/training/gbfs/

OUTCOMES:

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

1. Apply online communication techniques and collaboration skills (K3)
2. Enumerate the prihciples of digital ethics in online interactions (K2)
3. Understand the importance of Bureau of Indian Standards (BIS). (K2)

CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-
CO3	-	-	-	-	-	-	-	3	2	-	2	-	-

SEMESTER - II

24ESID201 SDG NO. 1-17	IDEA ENGINEERING LAB - II	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

To impart the basics of technologies that are used to identify sustainable solutions to societal problems

- To Provide awareness on Printed Circuit Board (PCB) design using ORCAD software.
- To Raise awareness of at least three Internet of Things (IoT) projects and their applications.

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- To Upskill learners through practical experience with 3D printing and scanning technologies.
- To prepare the learners to correctly align the ideas to SDGs
- To comprehensive knowledge on entrepreneurship and effective idea presentation techniques.
- To evaluate the effectiveness of SDGs and implementation strategy

MODULE-1 BASICS OF DESIGN THINKING IN ELECTRICAL AND ELECTRONIC COMPONENTS **4**

- Awareness Session on Basics of Design Thinking
- Study of Active & Passive Electronic Components
- Study of Basic AC & DC Electrical Circuits
- Study of Microprocessors & Microcontrollers
- Demonstration of Arduino Board, ESP 32 Board ,Raspberry Pi Board & PCB design software-Eagle
- Demonstration of PCB design using the software's Orcad, Eagle etc.

MODULE-2 EMBEDDED SYSTEMS, IOT AND ROBOTICS **4**

- Study of sensors and transducers
- Study of embedded protocols, IOT Protocols & Embedded C
- Demonstration of Robotics & Drone models

MODULE-3 BASICS OF MECHANICAL ENGINEERING **4**

- Study of Mechanical Modeling using Fusion 360
- Demonstration of 3D Scanner,3D Printer, Laser Cutter &RD Works Software
- Study of Slicer Software & Master Cam Software

MODULE 4 ALIGNMENT AND MAPPING OF IDEAS **4**

- **Project Title:** Justification of SDG and SAP - Problem Statement & Solution

MODULE-5 ENTREPRENEURSHIP SKILLS **4**

- Startup Awareness
- Entrepreneurship Opportunities
- Mock Presentations
- Innovation
- Novelty
- Feasibility
- Presentation Skills

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MODULE-6 SCOUT for SDG IDEATHON **12**

Evaluation Stages:

- First Round
- Second Round
- Idea Pitching

TOTAL: 30 PERIODS

REFERENCES:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020
2. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
3. Elements of Mechanical Engineering by N M Bhatt and J R Mehta, Mahajan Publishing House
4. Basic Mechanical Engineering by Pravin Kumar, Pearson Education
5. 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.
6. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2017.
7. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc24_ee112/preview
2. https://onlinecourses.nptel.ac.in/noc24_cs115/preview
3. https://onlinecourses.nptel.ac.in/noc24_me104/preview
4. https://onlinecourses.nptel.ac.in/noc24_me88/preview

OUTCOMES:

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

1. Gain the knowledge on Basic Electronics & Electrical Circuits (K2)
2. Understand the Basics of Embedded systems,IOT & Robotics (K1)
3. Explore the the Basics of Mechanical Modeling (K2)
4. Interpret the mapping of SDGs to ideas. (K4)
5. Illustrate the ideas in the Ideathon event emphatically .(K4)

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CO-PO, PSO MAPPING:

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

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SEMESTER - III

24BSMA302 - SDG NO. 4	LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- The aim of this course is to impart knowledge in the concepts of linear algebra as a prerequisite for the recent thrust areas of technological advancement.
- To know the importance of partial differential equations in modelling various engineering problems.

MODULE - I VECTOR SPACES **9**

Vectors and Linear combinations-Vector spaces (Definitions and examples) – Subspaces (Definitions and examples) – Linear independence and linear dependence – Bases and dimensions.

MODULE - II LINEAR TRANSFORMATION **12**

Linear transformation - Null and range spaces - Dimension theorem (Statement only) - Matrix of a linear transformation

MODULE - III INNER PRODUCT SPACES **9**

Inner product - Norm - Gram Schmidt orthogonalization process(Statement only) - QR decomposition.

MODULE - IV ADJOINT OPERATORS **9**

Adjoint of a linear operator - Least square approximation- Normal and self - adjoint operators.

MODULE - V SOLUTIONS OF FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS **12**

Solutions of standard types of first order partial differential equations - Singular integral - Complete integral – Lagrange's linear equation.

MODULE - VI SOLUTIONS OF LINEAR PARTIAL DIFFERENTIAL EQUATIONS **9**

Linear homogeneous and non-homogeneous partial differential equations of second and higher order with constant coefficients.

TOTAL: 60 PERIODS

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TEXT BOOKS:

1. Linear Algebra, Friedberg A.H., Insel A.J. and Spence L., 4th Edition, Pearson, 2018.
2. Transforms and Partial Differential Equation, Veerarajan T., 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., , New Delhi, 2016.

REFERENCES:

1. Linear Algebra and its applications, Strang G., 4th Edition, Thomson (Brooks/Cole), New Delhi, 2005.
2. Linear Algebra and its Applications ,Lay D. C. , 5th Edition, Pearson Education, 2015.
3. Linear Algebra – A Geometric Approach, Kumaresan S.,1st Edition, Prentice Hall of India, New Delhi, Reprint, 2010.
4. Higher Engineering Mathematics, B. V. Ramana, 11th reprint, Tata McGraw-Hill, New Delhi, 2010.
5. A text-book of Engineering Mathematics, N.P. Bali and Manish Goyal, Reprint, Laxmi Publications, 2008.
6. Higher Engineering Mathematics, B. S. Grewal, 40th Edition, Khanna Publishers, New Delhi, 2007.

WEB RESOURCES

1. https://theengineeringmaths.com/wp-content/uploads/2016/02/Partial-differential-equations.pdf
2. https://www.math.hkust.edu.hk/~mabfchen/Math111/Week7-9.pdf
3. https://math.mit.edu/~sschiavo/18-700/Lectures/LessonPlan17.pdf

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra
2. https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/video_galleries/video-lectures/
3. https://nptel.ac.in/courses/111106135
4. https://onlinecourses.nptel.ac.in/noc25_ma111/preview

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

1. Determine the bases and dimension of vector spaces and subspaces. (K3)
2. Analyse the matrix of a linear transformation for its rank and nullity. (K4)

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3. Construct an orthonormal basis using Gram-Schmidt orthogonalization process and use it for QR decomposition of a matrix. (K3)
4. Determine the adjoint of a linear operator and solve least squares approximation problems. (K3)
5. Classify the solutions of first order partial differential equations including Lagrange's linear equation. (K4)
6. Solve linear homogeneous and non-homogeneous partial differential equations of second and higher order with constant coefficients. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	-	3	-	-	-	-	-	-	-	-	-	3	3
CO3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO4	3	-	-	-	-	-	-	-	-	-	-	3	3
CO5	-	3	-	-	-	-	-	-	-	-	-	3	2
CO6	3	-	-	-	-	-	-	-	-	-	-	3	2

SEMESTER - III

24EEPC301 108106073 SDG NO. 4, 9, 11	ELECTROMAGNETIC FIELDS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To impart knowledge on mathematical and vector concepts related to electromagnetic fields.
- To describe electrostatic fields and their associated laws.
- To describe magnetostatic fields and their associated laws.
- To give insight to different methods of electromagnetic force generation and Maxwell's equations.

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- To impart knowledge on electromagnetic wave propagation and characterizing parameters.
- To explore real time applications of electromagnetic fields.

MODULE - I VECTOR ANALYSIS **8**

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields – Gradient, Divergence, Curl – theorems and applications.

MODULE - II ELECTROSTATICS **8**

Coulomb's Law–Electric field intensity–Field due to discrete and continuous charges– Gauss's law and its applications - Electric potential - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations - Capacitance, Energy and Energy density.

MODULE - III MAGNETOSTATICS **8**

Lorentz force, Magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuital Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) - Boundary conditions - Scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density.

MODULE - IV ELECTRODYNAMIC FIELDS **7**

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.

MODULE - V ELECTROMAGNETIC WAVES **7**

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance- skin depth - Poynting vector – Plane wave reflection and refraction.

MODULE - VI ELECTROMAGNETIC FIELD APPLICATIONS **7**

Electrostatic Discharge- Radio-frequency microelectromechanical systems (RF MEMS) - Super Capacitors - Magnetic Levitation and Wireless power transfer.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mathew N.O. Sadiku "Principles of Electromagnetics", 7th Edition, Oxford University PressInc,2018.

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2. William H. Hayt and John A. Buck and Jaleel M. Akhtar "Engineering Electromagnetics", McGrawHill, 9th edition, 2020.

REFERENCES:

1. S. Salivahanan, S. Karthie, " Electromagnetic Fields and Waves", 3rd Edition, Pearson Publication, 2024.
2. J.P.Tewari, "Engineering Electromagnetics - Theory, Problems and Applications",Second Edition, Khanna Publishers, 2013
3. Joseph. A.Edminister, "Schaum's Outline of Electromagnetics", fourth Edition(Schaum's Outline Series),McGrawHill,2018.
4. S.P.Ghosh, LipikaDatta, "Electromagnetic Field Theory", First Edition, McGraw Hill Education(India) Private Limited, 2017.
5. K.A.Gangadhar, "Electromagnetic FieldTheory", Khanna Publishers; Eight edition Reprint:2015.

WEB RESOURCES:

1. https://www.britannica.com/science/electrostatics
2. https://www.britannica.com/science/magnetostatics
3. http://www.clerkmaxwellfoundation.org/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108104087
2. https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/

OUTCOMES

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

1. Apply vector concepts related to electromagnetic fields for different coordinate systems.(K3)
2. Analyse the fundamental principles and laws of electrostatic fields, and calculate electric field intensity and potential for different charge distributions.(K4)
3. Analyse magneto static fields by using Biot–Savart's law and Ampere's law, and compute related magnetic forces and inductance.(K4)
4. Interpret Maxwell's equations for static and dynamic fields and the generation of electromagnetic forces in time-varying fields.(K4)
5. Explain the electromagnetic wave propagation, including key wave parameters, reflection, refraction, and energy flow.(K4)
6. Apply the concepts of Electromagnetic fields for various real time applications.(K3)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	-	-	1	-	-	-	-	-	3	2
CO3	3	3	3	-	-	1	-	-	-	-	2	2	2
CO4	3	3	3	-	-	1	-	-	-	-	2	2	2
CO5	3	3	3	-	-	1	-	-	-	-	2	2	2
CO6	3	3	3	-	-	1	-	-	-	-	2	2	2

SEMESTER - III

24EEPC302 108105155 SDG NO. 4	ELECTRICAL MACHINES - I	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To explain the principles of electromechanical energy conversion and magnetic circuits.
- To describe the construction, operation and types of DC machines
- To analyze the performance characteristics and testing methods of DC machines.
- To investigate the speed control techniques of DC motors.
- To illustrate the construction, working principles and performance analysis of transformers.
- To examine real-world applications of DC machines and transformers.

MODULE - I PRINCIPLES OF ENERGY CONVERSION **8**

Basic magnetic circuit analysis, Faraday's law of electromagnetic induction –singly and doubly excited magnetic field systems – torque production in rotating machines.

MODULE - II DC GENERATORS **8**

Construction, principle of operation of DC generator – emf equation– types, Characteristics, commutation - armature reaction, Losses and Efficiency – Condition for maximum efficiency.

MODULE - III DC MOTORS **8**

Principle of operation – torque equation of DC motor– types – electrical & mechanical characteristics –starting – speed control - braking.

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MODULE - IV TRANSFORMERS 7

Constructional details of transformers – Principle of operation – EMF equation – Equivalent circuit – Transformer on no-load and load –Voltage Regulation – Auto transformers – Three phase transformers.

MODULE - V TESTING OF DC MACHINES AND TRANSFORMERS 7

Testing of DC machines – Brake test, Swinburne's test and Hopkinson's test – Testing of transformers – load test – Sumpner's test - All day efficiency

MODULE - VI APPLICATIONS OF DC MACHINES AND TRANSFORMERS 7

DC machines for industrial applications; conventional transformers for power transmission and distribution- smart transformers for modern power systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Dr. P.S. Bhimbra, "Electrical Machinery", Khanna Publications, Revised Edition, 2021
2. Nagrath, I.J. and Kothari, D.P., "Electrical Machines", Tata McGraw-Hill Education Private Limited Publishing Company Ltd., 5th Edition, 2017.
3. B. L. Theraja and AK Theraja, "A Textbook of Electrical Technology", Volume 2, S. Chand Publications, 2015.
4. A.K. Sawhney, "A Course in Electrical Machine Design" , DhanpatRai and Sons, New Delhi, 1984.

REFERENCE BOOKS:

1. A.E. Fitzgerald and Charles Kingsley, "Electric Machinery", Tata McGraw-Hill Education Publications, Revised Edition, 2022.
2. Vincent Del Toro, "Electrical Engineering Fundamentals", 4th Edition, Prentice Hall Publications, 2017.
3. Parker Smith, N.N., 'Parker Smith's Problems in Electrical Engineering', 9th Edition, CBS Publishers and Distributors, 9th Edition, 2003.

WEB RESOURCES:

1. https://www.electricaleasy.com
2. https://www.electrical4u.com

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108105155
2. https://nptel.ac.in/courses/108102146
3. https://www.sciencedirect.com/search?qs=electrical%20machines

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OUTCOMES

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

1. Apply the principles of electromechanical energy conversion and the concepts of magnetic circuits in electrical machines.(K3)
2. Examine the basic construction and working of DC generators, commutation and losses affect their performance.(K4)
3. Analyze the performance of DC motors under different conditions of operation, control, and braking.(K4)
4. Interpret the behavior of transformers using equivalent circuits and voltage regulation for various configurations.(K4)
5. Make use of practical tests to study the performance of DC machines and transformers. (K3)
6. Categorise the use of DC machines and transformers in real-world industrial and power system applications. (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	-	-	-	-	2
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1
CO3	2	1	2	-	-	-	-	-	-	-	-	-	2
CO4	1	2	1	-	-	-	-	-	-	-	-	-	1
CO5	2	1	2	-	-	-	-	-	-	-	-	-	2
CO6	1	2	2	-	-	-	-	-	-	-	-	-	2

SEMESTER - III

24EEPC303 108101094 / 108106084 SDG NO. 4	ANALOG ELECTRONICS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To develop the amplifier circuits by applying the biasing concept.
- To design different types of amplifiers and analyse their response.
- To understand the concept of an oscillator and its types.
- To comprehend the characteristics and applications of OPAMP.
- To analyze the concept of OP AMP used for various applications.
- To design and implement analog ICs for real world applications.

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MODULE - I FET AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 7

BJT - Biasing circuits, JFET and MOSFET, Characteristics of CS, CG and CD amplifier configurations and Biasing circuits, Differential amplifier - Common mode and Difference mode analysis, Cascode Amplifier.

MODULE - II POWER AMPLIFIERS 7

Classification of Feedback Amplifiers - Advantages of Negative feedback , Power amplifiers:- Class A, B and C Power amplifiers, Class AB Push-Pull - cross-over distortion, Complementary Symmetry Push-Pull amplifiers - Design of power output and efficiency.

MODULE - III OSCILLATORS 7

Barkhausen criterion for oscillation, Hartley and Colpitts oscillators, Phase shift, Wein bridge, Crystal oscillators and Clapp oscillator.

MODULE - IV OP- AMP CHARACTERISTICS 8

OP-AMP characteristics - DC characteristics, AC characteristics. Basic applications of op-amp – Inverting and Non-inverting Amplifiers, differential amplifier, summer, differentiator and integrator, V/I and I/V converter.

MODULE - V OP- AMP APPLICATIONS 8

Instrumentation amplifier, Multivibrators, peak detector, clippers, S/H circuit - D/A converter - weighted resistor and R- 2R ladder types, A/D converters - flash type, dual slope type and successive approximation type.

MODULE - VI TIMERS AND REGULATORS 8

IC555 Timer, Monostable and Astable modes of operation – Fixed voltage regulators LM78XX, LM79XX, Variable voltage regulator 723, Switching regulator.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. A.S. Sedra, K.C. Smith, T.C. Carusone, and V. Gaudet, "Microelectronics Circuits", 2019, 8th edition, Oxford university press.
2. D.Roy Choudhary, Shail Bala Jain, "Linear Integrated Circuits", Fifth edition, New Age International Publishers, 2018.

REFERENCES:

1. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.

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2. Robert L. Boylestad & Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th Edition January 2015
3. S.Salivahanan, V.S.Kanchana Bhaaskaran, "Linear Integrated Circuits and Applications", First edition, 2018, McGraw Hill Education.
4. Ramakant A.Gayakward, "Op-amps and Linear Integrated Circuits", Fourth edition (25 May 2015), Pearson Education.

WEB RESOURCES:

1. https://www.electronics-tutorials.ws/
2. https://archive.nptel.ac.in/courses/108/105/108105158/
3. https://archive.nptel.ac.in/courses/108/106/108106084/
4. https://www.khanacademy.org/science/electrical-engineering/eeamplifiers
5. https://nptel.ac.in/courses/117107094/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117103063/
2. https://www.coursera.org/specializations/semiconductor-devices
3. http://www.nptelvideos.in/2012/11/digital-integrated-circuits.html
4. https://nptel.ac.in/courses/108/108/108108111/

OUTCOMES

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

1. Analyze the biasing techniques of BJT, JFET and MOSFET amplifiers to design analog amplifier circuits. (K4)
2. Apply the principles of negative feedback to summarize the characteristics, evaluate the efficiency and distortion characteristics of various classes of power amplifiers. (K3)
3. Make use of the positive feedback and principle of Barkhausen criterion to determine the frequency of oscillation of various oscillators. (K3)
4. Construct the basic amplifier circuits using OP-AMP and summarize its characteristics. (K3)
5. Analyze the concept of OP-AMP used in various linear and non linear applications. (K4)
6. Develop the timer circuits and regulators for engineering applications. (K3)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	2	2	-
CO2	3	3	2	-	-	-	-	-	-	-	2	2	-
CO3	3	3	2	-	-	-	-	-	-	-	2	2	-
CO4	3	3	2	-	-	-	-	-	-	-	2	2	-
CO5	3	3	2	-	-	-	-	-	-	-	2	2	-
CO6	3	3	2	-	-	-	-	-	-	-	2	2	-

SEMESTER - III

24EEPC304 108105132 SDG NO. 4	DIGITAL ELECTRONICS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the design of integrated circuits.
- To study the simplification methods of the logical expressions.
- To study the design of combinational circuits.
- To learn the design of synchronous and asynchronous circuits.
- To design various Programmable Logic Devices and to apply VHDL to design and implement digital circuits.
- To learn the real time applications of digital logic circuits.

PRE REQUISITES:

- Basic knowledge about Number system
- Logic Gates functioning

MODULE - I DIGITAL INTEGRATED CIRCUITS 8

Logic families and their characteristics: RTL, DTL, TTL, CMOS, and ECL integrated circuits and their performance comparison – Logic levels, propagation delay time, power dissipation, fan-out and fan-in, noise margin.

MODULE - II BOOLEAN FUNCTIONS 7

DeMorgan's theorems – Realization of switching functions using logic gates – Switching equations – Canonical logic forms – Sum of Products (SOP) and

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Product of Sums (POS) – Simplification of Boolean Functions using Karnaugh map.

MODULE - III IMPLEMENTATION OF BASIC COMBINATIONAL CIRCUITS 7

Binary adder, subtractor, BCD adder, code convertors, decoder, encoder, priority encoder, multiplexers, demultiplexers, binary comparator – Hazards in digital logic circuits.

MODULE - IV SEQUENTIAL LOGIC CIRCUITS 8

Working of SR, JK, D and T flip-flops – Clocked and edge triggered flipflops – Asynchronous and synchronous counters – Shift Registers – State diagrams and state tables – State table reduction – Excitation table and state equations – Design and analysis of simple synchronous sequential circuits – Mealy and Moore models.

MODULE - V PROGRAMMABLE LOGIC DEVICES AND DIGITAL SIMULATION 8

Programmable Logic Devices – Programmable Read-Only Memory, Programmable Logic Arrays and Programmable Array Logic, Field Programmable Gate Arrays, CPLD. Introduction to VHDL – Operators – Simple coding for combinational logic circuits- Adder, subtractor, multiplexer and demultiplexer, simple coding for sequential circuits- Flip-Flops, counter, shift registers.

MODULE - VI APPLICATIONS OF DIGITAL LOGIC CIRCUITS 7

Real-time examples of digital logic circuits: Automatic vending machines, digital stopwatches, digital calculators, traffic light controllers, automatic door locks, industrial automation systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. R P. Jain, KishorSarawadekar, "Modern Digital Electronics", 5th Edition, mcGrawHill, 2022.
2. Kumar, A. Anand, "Fundamentals Of Digital Circuits", 4th edition, PHI, 2016.

REFERENCE BOOKS:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL and system Verilog", 6th edition, Pearson Publication, 2018.

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2. S. Salivahanan, S. Arivazhagan, " Digital Circuits And Design" 5th Edition, Oxford University Press, March 2018.
3. Charles H. Roth, Jr., Larry L. Kinney, and Eugene B. John, " Fundamentals of Logic Design, Enhanced Seventh Edition, Cengage Publications, 2019.
4. Natarajan R Ananda, " Digital Design" PHI publications, 2015.

WEB RESOURCES:

1. https://youtu.be/M0mx8S05v60?si=Rhnj0TaF0QkBA9QB
2. https://youtu.be/FKvnmxte98A?si=2eDD4Cr13G0MzdWL
3. https://youtu.be/WW-NPtIzHwk?si=XX6wvDHyxNvXTYnH

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/108/105/108105132/
2. https://archive.nptel.ac.in/courses/108/105/108105113/
3. https://nptel.ac.in/courses/106108099
4. https://nptel.ac.in/courses/108106069

OUTCOMES

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

1. Apply the characteristics of various logic families to obtain their performance based on logic levels. (K3)
2. Utilize Boolean algebra and Karnaugh maps to simplify logic functions.(K3)
3. Construct arithmetic and control logic circuits using combinational design techniques and identify static and dynamic hazards in digital logic systems.(K3)
4. Analyze the simple sequential circuits. (K4)
5. Apply the concepts of programmable logic devices and VHDL code in digital system design. (K3)
6. Make use of digital logic circuits in real-time systems.(K3)

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CO1	3	3	2	-	-	-	-	-	-	-	-	2	1
CO2	3	3	2	-	-	-	-	-	-	-	-	2	1
CO3	3	3	2	-	-	-	-	-	-	-	-	2	1
CO4	3	3	2	-	-	-	-	-	-	-	-	2	1
CO5	3	3	2	-	-	-	-	-	-	-	-	2	1
CO6	3	3	2	-	-	-	-	-	-	-	-	2	1

SEMESTER - III

24HSMC301 - SDG NO. 4, 9	UNIVERSAL HUMAN VALUES – II UNDERSTANDING HARMONY	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Developing clarity with harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.
- Recognizing the potential of excellence than competition

SYLLABUS:

The course has 28 lectures and 14 practice sessions in 6 modules:

MODULE - I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION (5+2)

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration-what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self- exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario

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Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

MODULE - II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF (5+2)

6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.
7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

MODULE - III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY HARMONY IN HUMAN-HUMAN RELATIONSHIP (6+2)

12. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values ofrelationship
13. Understanding the meaning of Trust; Difference between intention and competence
14. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
15. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

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MODULE - IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE (6+2)

16. Understanding the harmony in the Nature
17. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature
18. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
19. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion ofresources and role of technology etc.

MODULE - V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS (4+4)

20. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family
21. Natural acceptance of human values
22. Definitiveness of Ethical Human Conduct
23. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
24. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

MODULE - VI UNIVERSAL HUMAN ORDER (4+3)

25. Programs to ensure Sanyam and Health
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.

REFERENCES:

1. AICTE Model Curriculum in Humanities, Social Science and Management Courses (UG Engineering & Technology)Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values,A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence-JC Kumarappa
8. Bharat Mein Angreji Raj- Pandit Sunderlal
9. Rediscovering India- by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda- Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

OUTCOMES

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

1. Express the harmony of relationship among human being, family, society, nature and existence with right understanding and right feeling.(K2)
2. Develop the responsibility of handling problems by finding holistic and sustainable solutions based on the natural acceptance for maintaining mutual human relationships. (K2)
3. Develop a holistic perspective of life based on self-exploration about self, family, society and nature/existence. (K2)
4. Elucidate a critical ability for dedicative commitment towards human values, relationships and society. (K2)
5. Implement the process of verification and validation of learning in daily life. (K2)
6. Develop self reflection, commitment and courage to act in life challenging situations. (K2)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	3	3	2	-	-	3
CO2	-	1	-	-	-	3	3	2	-	-	-
CO3	-	-	3	-	-	3	3	2	-	-	-
CO4	-	-	-	-	-	3	3	2	-	2	3
CO5	-	-	-	-	-	3	3	-	-	-	3
CO6	-	-	-	-	-	3	3	-	-	3	2

SEMESTER - III

24HSNC301 – SDG NO. 4	NCC COURSE LEVEL 2	L	T	P	CP	C
		3	0	0	3	0

ARMY WING

PERSONALITY DEVELOPMENT **9**

PD 3 Group Discussion: Change your mindset, Time Management, Social Skills 6

PD 5 Public Speaking 3

LEADERSHIP **7**

L 2 Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965 7

DISASTER MANAGEMENT **13**

DM 1 Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation 3

DM 2 Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters 9

DM 3 Fire Service & Fire Fighting 1

ENVIRONMENTAL AWARENESS & CONSERVATION **3**

EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS **4**

GA 1 General Knowledge 4

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ARMED FORCES 6

AF 1	Armed Forces, Army, CAPF, Police	6

ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

BORDER & COASTAL AREAS 2

BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL: 45 PERIODS

NAVAL WING

PERSONALITY DEVELOPMENT 9

PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3

LEADERSHIP 7

L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7

DISASTER MANAGEMENT 13

DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1

ENVIRONMENTAL AWARENESS & CONSERVATION 3

EA 1	Environmental Awareness and Conservation	3

GENERAL AWARENESS 4

GA 1	General Knowledge	4

NAVAL ORIENTATION 6

AF 1	Armed Forces and Navy Capsule	3
EEZ 1	EEZ Maritime Security and ICG	3

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ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

BORDER & COASTAL AREAS 2

BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL: 45 PERIODS

AIR FORCE WING

PERSONALITY DEVELOPMENT 9

PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3

LEADERSHIP 7

L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7

DISASTER MANAGEMENT 13

DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1

ENVIRONMENTAL AWARENESS & CONSERVATION 3

EA 1	Environmental Awareness and Conservation	3

GENERAL AWARENESS 4

GA 1	General Knowledge	4

GENERAL SERVICE KNOWLEDGE 6

GSK 1	Armed Forces & IAF Capsule	2
GSK 2	Modes of Entry in IAF, Civil Aviation	2
GSK 3	Aircrafts - Types, Capabilities & Role	2

ADVENTURE 1

AD 1	Introduction to Adventure Actitivities	1

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BORDER & COASTAL AREAS **2**

BCA 1 History, Geography & Topography of Border/Coastal areas 2

TOTAL :45 PERIODS

SEMESTER - III

24EEPL301 - SDG NO. 4, 9	ANALOG AND DIGITAL ELECTRONICS LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To enable students to design and implement combinational and sequential logic circuits using standard ICs for solving digital system design problems.
- To develop analytical skills in code conversion and error detection techniques for enhancing reliability in digital communication systems.
- To provide knowledge and experimental skills for characterizing semiconductor devices and designing analog circuits using op-amps and 555 timers for practical applications.

LIST OF EXPERIMENTS

1. Implementation of Adder, subtractor circuits.
2. Code converters: Binary to Gray code converter and vice-versa.
3. Implementation of parity generator and parity checker circuits.
4. Implementation of Priority Encoders and Binary Decoders
5. Implementation of Asynchronous Decade Counters.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Implementation of multiplexer and demultiplexer.
8. Experimental characterization of PN junction diode and Zener Diode.
9. Experimental Characterization of BJT, JFET.
10. Application of Op-Amp: inverting and non-inverting amplifier, Integrator and Differentiator.
11. Timer IC application: Study of NE/SE 555 timer in Astable and Monostable mode operations.
12. Experimental design of RC phase shift oscillator using BJT.

TOTAL : 60 PERIODS

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LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Sl No.	Name of the equipment / component	Quantity	Remarks
1.	Digital Trainer Kit	10	
2.	Dual,(0-30V)variable Power Supply	10	-
3.	CRO 9	30MHz	
4.	Digital Multimeter	10	Digital
5.	Function Generator	8	1MHz
6.	IC Tester (Analog)	2	
7.	Breadboard 10		
8.	IC741/ICNE555	10	
9.	Digital IC types		
10.	Transistor-BC 107		
11.	Diodes,IN4001		
12.	Zener diodes		
13.	Capacitors		
14.	JFET semiconductor device -BFW10		
15.	Digital Storage Oscilloscope	1	
16.	Resistors		
17.	Single Strand Wire		
18.	Consumables (Sufficient quantity)		

OUTCOMES

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

1. Design and implement combinational and sequential logic circuits, including adders, subtractors, encoders, decoders, counters, and shift registers. (K3)
2. Analyze and demonstrate digital techniques for code conversion, error detection/correction, and communication reliability using parity generation and checking mechanisms. (K4)
3. Evaluate the characteristics of semiconductor devices and design analog circuits using diodes, BJTs, JFETs, op-amps, and 555 timers for amplifier, oscillator, and waveform-shaping applications. (K5)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	2	-	-	-	-	-	2	1	-
CO2	2	2	2	-	2	-	-	-	-	-	2	1	-
CO3	2	2	2	-	2	-	-	-	-	-	2	1	-

SEMESTER - III

24EETP301 - SDG NO. 4	APTITUDE SKILLS - I	L	T	P	CP	C
		0	0	2	2	1

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Enrich students on quantitative ability, reasoning ability, and verbal ability
- Build a strong foundation for solving recruitment-based problems with speed and accuracy.
- Enhance creative thinking skills and Strengthen problem-solving skills.

MODULE - I QUANTITATIVE ABILITY **22**

Number Properties, Speed Math, HCF and LCM, Percentages, Time and Work, Time Speed and Distance, Ratio Proportion and Variations, Averages Mixtures and Alligation

MODULE - II QUANTITATIVE ABILITY AND REASONING ABILITY **16**

Profit and Loss, Simple Interest and Compound Interest, Blood Relation, Directions, Coding and Decoding, Series, Ranking and Arrangements

MODULE - III VERBAL ABILITY **7**

Verbal Analogy – Vocabulary building – Sentence Structures - Comprehension – correct usage of words – Error deduction

TOTAL: 45 PERIODS

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REFERENCES:

1. Quantitative Aptitude for Competitive Examinations – R.S. Aggarwal
2. A Modern Approach to Logical Reasoning – R.S. Aggarwal
3. High School English Grammar & Composition – Wren & Martin
4. Word Power Made Easy – Norman Lewis.
5. Fast Track Objective Arithmetic – Rajesh Verma

LIFE SKILLS, RANGER AND ROVER & BIS STANDARDS – PHASE 2

OBJECTIVES:

- Familiarize the team skills and life skills.
- Familiarize with the Indian Standards on various electrical components

MODULE - I JEEVAN KAUSHAL 2.0 – TEAM SKILLS AND LIFE SKILLS 12

Trust and Collaboration: Importance of Trust in Creating a Collaborative Team- Agree to Disagree and Disagree to Agree – Spirit of Teamwork - Understanding Fear of Being Judged and Strategies to Overcome.

Brainstorming: Basics and the process – Effective technique for ideation – Types – Importance and Benefits

Internal Communication: Internal Communication – Meaning and the Need, Use of Various Channels for Transmitting Information to Team Members including Digital and Physical.

Leadership Skills: Leadership concept - Leadership skills – Leadership moralities – Leadership models

MODULE - II RANGER AND ROVER 10

Four Bonds of BSG: Sign, Salute, Left Handshake, Moto and Good Turn.

Discipline and Uniform: Uniform of Rovers and Rangers, 14 Programme ideals.

Knowledge of Merit: Know about Knowledge of Merit Badges (Proficiency Badge).

Sustainability E-learning: (Online Course Available in WOSM Learning Zone).

Activating the Earth Tribe Initiative in your Community.

MODULE - III INDIAN STANDARDS ON TRANSFORMERS AND MOTORS 8

Transformers: Working Principle of Transformer, Classification of Transformers, Tests of Transformers, Indian Standards available on various types of transformers

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Motors: Part 1: Introduction to Motors & Uses of Motors in India- Fundamentals of Motors - Operation of DC Motor - Operation of Ac Motors - Operation of AC Induction Motors - Operation of AC Synchronous Motors - Motor Efficiency - Major Types of Motors Losses Explained - Main Strategies to Reduces Loss - Importance of Motor Standardization

Part 2: Summary and explanation of Important Indian Standards - IS 12615: 2018–IS 996: 2009 –IS 9283:2013 -IS 15999 series -IS/IEC 60034-5: 2000 -IS 6362:1995 (IEC Pub 34-6: 1991) -IS 12075: 2008.

TOTAL: 30 PERIODS

REFERENCES:

1. Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0, UGC, New Delhi.
2. A World Built on Standards: A Textbook for Higher Education, Published by: Danish Standards Foundation, 2015.
3. SO / IEC Guide 59, BIS Standards Formulation Manual, 2nd Revision, 2022.

ONLINE RESOURCES:

1. https://lms.scout.org/course_items/show/1172182?course_id=214307#course-item-id=1172182
2. https://lms.scout.org/courses/show/214123?force_course_hub=true
3. https://www.ugc.gov.in/pdfnews/4874522_Draft-Curriculum-for-Life-SKill-Jeevan-Kaushal.pdf (ugc.gov.in)

OUTCOMES

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

1. Apply quantitative aptitude for solving numerical problems [K3]
2. Describe logical reasoning to tackle emotional challenges. [K2]
3. Use verbal communication and comprehension skills through grammar and language exercises. [K3]
4. Apply critical thinking and problem-solving skills in various cognitive scenarios. [K3]
5. Interpret language nuances in diversified situations and exhibit scouting spirits amidst communities. [K2]
6. Summarize the importance of Indian Standards on various electrical components. (K2)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	1	1	-
CO2	-	-	-	-	-	2	-	-	-	-	1	1	-
CO3	-	-	-	-	-	-	-	-	2	-	1	1	-
CO4	-	2	-	-	-	-	-	-	-	-	1	1	-
CO5	-	-	-	-	-	-	-	2	3	-	1	1	-
CO6	2	-	2	2	2	-	-	-	-	-	2	2	2

SEMESTER - III

24EEID301 - SDG NO. 4,11,15	INNOVATIVE DESIGN LAB - I	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To provide opportunities for students to develop an entrepreneurial mindset and explore real-world problem-solving through a startup-centric approach.
- To enable hands-on experience in identifying market needs
- To enable development of skill sets for designing, validating, and realizing a Minimum Viable Product (MVP) for an entrepreneurial venture.
- To guide students in validating market opportunity, and formulating a solution with realistic constraints.
- To inculcate ethical research practices, foster a commitment to lifelong learning, and promote the development of socially responsible and sustainable innovations aligned with relevant Sustainable Development Goals (SDGs).
- To prepare students to design sustainable business models and present entrepreneurial ideas through structured, outcome-driven business pitches using core startup frameworks.

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COURSE METHODOLOGY:

1. This initiative is designed to inculcate ethical principles of research and to get involved in a life-long learning process for the students, specifically through the lens of entrepreneurship and innovation.
2. The project work must involve identifying a problem, validating market opportunity, and developing a solution with realistic constraints, culminating in a business plan and prototype/MVP. It must also include appropriate elements of the following: market research, competitive analysis, value proposition design, business model development, financial feasibility, go-to-market strategy, and potentially software/hardware development for the MVP.
3. Project can be individual work or a group project, with a maximum of 3 students. In case of a group project, the individual project report of each student should specify the individual's contribution to the group project. The roles and responsibilities of all team members must be well-defined and documented.
4. On completion of the project, the student shall submit a detailed project report outlining their entrepreneurial journey, solution development, and business plan. The project should be reviewed and the report shall be evaluated, and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION:

1. First evaluation (Milestone 1 - Week 4): 20 marks (Focus on Problem Identification, Opportunity Discovery, Customer & Markets, Value Proposition)
2. Second evaluation (Milestone 2 - Week 8): 30 marks (Focus on Competitive Advantage, Business Model, and MVP Development)
3. Final evaluation (Milestone 3 & 4 - Last week of the semester): 50 marks (Focus on Financial Feasibility, Go-to-Market Strategy, Growth and Scale, Funding Strategy, and Overall Project Report & Viva-Voce)

Note: All three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 45 PERIODS

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OUTCOMES:

At the end of the course, the student should be able to:

1. Apply entrepreneurial thinking to identify and articulate real-world problems and explore market needs using structured approaches. (K3)
2. Develop skill sets to design potential solutions and validate market opportunities within realistic constraints. (K4)
3. Evaluate sustainable, ethical, and responsible innovation strategies, and communicate business models effectively. (K5)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	2	-	-	-	2	2
CO2	3	3	2	-	-	-	-	2	-	-	-	2	2
CO3	3	3	2	-	-	-	-	2	-	-	-	2	2

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SEMESTER - IV

24BSMA403 - SDG NO. 4	STATISTICS AND NUMERICAL METHODS	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To identify relationship between multiple input variables
- To introduce the basic concepts of solving algebraic and transcendental equations
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines
- To introduce the knowledge of various techniques and methods of solving ordinary and partial differential equations

MODULE - I TESTING OF HYPOTHESIS **12**

Sampling distributions - Statistical hypothesis - large sample tests based on single proportion and difference proportions, single mean and difference of means -Tests based on t, and F-distributions for mean, variance respectively - Chi-square test for independence of attributes - Goodness of fit.

MODULE - II DESIGN OF EXPERIMENTS **9**

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

MODULE - III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **12**

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 - Maximum Eigenvalues of a matrix by Power method.

MODULE - IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION **9**

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single integrals using Trapezoidal and Simpson's 1/3 rules.

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Board of Studies of H&S dept.
Meeting No. 6 Dated: 31/5/2024

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Department of Humanities & Sciences

MODULE - V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **9**

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 method : Milne's predictor corrector method for solving first order differential equations.

MODULE - VI NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS **9**

Solution of two-dimensional Laplace's and Poisson's equations on rectangular domain-Forward time central space scheme - One dimensional heat flow equation by Crank Nicholson Method-One dimensional wave equation by explicit method.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Miller and Freund's Probability and Statistics for Engineers, Johnson, R.A., Miller, I and Freund J., 8th Edition, Pearson Education, Asia, 2015.
2. Numerical methods for Scientific and Engineering Computation, Jain M. K., Iyengar S. R. K. , Jain R. K., 4th Edition, New Age international Publishers, 2003
3. Numerical Methods in Engineering and Science, Grewal. B.S. and Grewal. J.S., 10th Edition, Khanna Publishers, New Delhi, 2015.

REFERENCES:

1. Numerical Analysis, Burden, R. L. and Faires, J. D., 9th Edition, Cengage Learning, 2016.
2. Probability and Statistics for Engineering and the Sciences, Devore J. L., 8th Edition, Cengage Learning, New Delhi, 2014.
3. Applied Numerical Analysis, Gerald C. F. and Wheatley P.O., 7th Edition, Pearson Education, Asia, New Delhi, 2006.
4. Probability and Statistics for Engineers and Scientists, Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., , 8th Edition, Pearson Education, Asia, 2007.
5. Numerical methods, Kandasamy P., Thilagavathy K., Gunavathy K., 3rd Edition, S. Chand, 2006.

WEB REFERENCES:

1. https://www.classcentral.com/course/swayam-numerical-analysis-17709
2. https://online-learning.harvard.edu/course/statistics-and-r?delta=1

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Department of Humanities & Sciences

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3057/numerical-methods-and-computation
2. https://nptel.ac.in/courses/111107105/

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

1. Apply appropriate statistical hypothesis tests for large and small samples to make inferences about population parameters using t, F, and Chi-square distributions. (K3)
2. Apply appropriate experimental designs such as CRD, RBD, and Latin Square to analyze and interpret data from one-way and two-way classifications. (K3)
3. Apply numerical methods to solve algebraic, transcendental, and linear systems of equations, and compute dominant Eigenvalues using the Power method. (K3)
4. Apply interpolation techniques and numerical methods to approximate derivatives and evaluate definite integrals. (K3)
5. Apply single-step and multi-step numerical methods to solve first-order ordinary differential equations. (K3)
6. Apply finite difference methods to solve partial differential equations such as Laplace, Poisson, heat, and wave equations. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO4	3	-	-	-	-	-	-	-	-	-	-	3	2
CO5	3	-	-	-	-	-	-	-	-	-	-	3	3
CO6	3	-	-	-	-	-	-	-	-	-	-	3	3

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Meeting No. 6 Dated: 31/5/2024

S. Ramakrishnaiah

Chairman
Board of Studies
Department of Humanities & Sciences

SEMESTER - IV

24EEPC401 - SDG NO. 4, 12	TRANSMISSION AND DISTRIBUTION	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To study the structure of electric power systems, need of EHV and HVDC transmission systems.
- To develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuit and study the performance of the transmission lines.
- To understand the mechanical design of transmission lines and to analyze the voltage distribution in insulator strings.
- To study the construction of cables and methods of grading.
- To understand the types of distribution system, techniques of voltage control and power factor improvement.

PRE REQUISITE: Basic Electrical Engineering, Circuit Theory

MODULE - I TRANSMISSION SYSTEM OVERVIEW 6

Structure of power system –Indian power grid scenario - Transmission system classification – Advantages of high transmission voltage–Types of conductors – Line supports – Types of towers – Need of EHV and HVDC transmission system.

MODULE - II TRANSMISSION LINE PARAMETERS 8

Resistance, inductance and capacitance of single and three phase transmission lines - Self and mutual GMD; skin and proximity effects - Simulation study on inductance and capacitance effects in transmission line.

MODULE - III MODELLING AND PERFORMANCE OF TRANSMISSION LINES 8

Performance of short, medium and long lines - Equivalent circuits, phasor diagram - Transmission efficiency and voltage regulation - Phenomenon of corona – Corona loss - Critical voltages – Effect on line performance.

MODULE - IV MECHANICAL DESIGN OF LINES 8

Tension and sag calculation – Effects of wind and ice loading. Insulators: types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

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MODULE - V UNDERGROUND CABLES **8**

Types of cables – Constructional features – Insulation resistance – Potential gradient-Capacitance of single core and three core cables-Grading of cables - Heating of cables.

MODULE - VI DISTRIBUTION SYSTEMS **7**

Classification of distribution systems –Kelvin's law - AC and DC distribution calculation - Techniques of voltage control with case study - Power factor improvement – Distribution loss – Types of substations.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. C.L.Wadhwa, "Electrical Power Systems", New Academic Science Ltd,2009.
2. S.N. Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition,2011.

REFERENCES:

1. B.R.Gupta, "Power System Analysis and Design" S. Chand, New Delhi, Sixth Edition, 2011.
2. V.K.Mehta, Rohit Mehta, "Principles of power system", S. Chand & Company Ltd, New Delhi, Third Edition, 2005.
3. D.P.Kothari, I.J. Nagarath, "Power System Engineering", McGraw-Hill Publishing Company limited, New Delhi, Third Edition, 2019.
4. Luces M.Fualken berry, Walter Coffer,"Electrical Power Distribution and Transmission", Pearson Education, First Edition, 2006.

WEB REFERENCES:

1. https://www.electrical4u.com/transmission-line-in-power-system
2. https://www.electricaleasy.com/2017/03/underground-power-cables.html
3. https://www.eeeguide.com/insulating-materials-for-underground-cables

ONLINE RESOURCES:

1. https://www.coursera.org/lecture/electric-power-systems/transmission-subtransmission-imo4x
2. https://martechmedia.com/index.php/technical-elearning/course-catalog/electrical-distribution/

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OUTCOMES

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

1. Describe the structure of modern power system and significance of high voltage transmission system. (K2)
2. Apply standard methods to compute resistance, inductance and capacitance of transmission lines for the given conductor configuration. (K3)
3. Analyze the performance of transmission lines and the impact of corona. (K4)
4. Examine the mechanical design of transmission lines and string efficiency in insulator strings. (K4)
5. Identify the electrical parameters of underground cables. (K3)
6. Solve basic analytical problems in distribution system and summarize the importance of voltage control and power factor improvement. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	2	1	1
CO2	3	2	2	-	1	-	-	-	-	-	2	2	1
CO3	3	2	2	-	-	-	-	-	-	-	2	2	1
CO4	3	2	2	-	-	-	-	-	-	-	2	2	1
CO5	3	2	2	-	-	-	-	-	-	-	2	2	2
CO6	3	2	2	-	-	-	-	-	-	-	2	2	1

SEMESTER - IV

24EEPC402 108105131 SDG NO. 8,9	ELECTRICAL MACHINES-II	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To study the construction and performance of salient and non – salient type synchronous generators.
- To impart knowledge on the principle of operation and performance of synchronous motors.
- To study the construction, principle of operation and performance of induction machines.
- To study different Starting and speed control of three-phase induction motors.

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- To study the construction, principle of operation and performance of single phase induction motors.
- To introduce the special machines.

MODULE - I SYNCHRONOUS GENERATORS 7

Constructional details – Types of rotors – EMF equation – Armature reaction – Voltage regulation – EMF, MMF, ZPF and A.S.A methods – Two reaction theory – Slip test -Synchronizing and Parallel operation.

MODULE - II SYNCHRONOUS MOTORS 7

Principle of operation – V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed - Hunting – damper windings- Synchronous condenser.

MODULE - III THREE PHASE INDUCTION MOTORS 7

Constructional details – Types of rotors –- Principle of operation – Slip – Torque Equation - Condition for maximum torque - Torque-Slip characteristics – Equivalent circuit - Losses and efficiency – Load test - No load and blocked rotor tests - Separation of losses – Induction generator.

MODULE - IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTORS 8

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star- delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor - Plugging, dynamic braking and regenerative braking.

MODULE - V SINGLE PHASE INDUCTION MOTORS 8

Constructional details of single phase induction motors – Double field revolving theory – Equivalent circuit – No load and blocked rotor test – Starting of single-phase induction motors – Capacitor-start capacitor run Induction motor-Shaded pole Induction Motor.

MODULE - VI SPECIAL MACHINES 8

Stepper motors– Repulsion motor - Hysteresis motor - Servo motors - Permanent Magnet Brushless DC motor.

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. J.B.Gupta, "Theory and Performance of Electrical Machines", S.K.Kataria & Sons , 15th Edition 2015.
2. B.L.Theraja and A.K.Theraja, "A Textbook of Electrical Technology", S.Chand, 2012.
3. Vincent Del Toro, "Basic Electric Machines" Pearson India Education, 2016.
4. E.G. Janardanan, "Special electrical machines", PHI learning Private Limited, Delhi, 2014.

REFERENCE BOOKS:

1. P.S.Bimbhra, "Electrical Machinery", Khanna Publishers, 7th Edition, Reprint, 2013.
2. B.R. Gupta, "Fundamental of Electric Machines", New age International Publishers, 3rd Edition, Reprint 2015.
3. S.K. Bhattacharya, "Electrical Machines", McGraw - Hill Education, New Delhi, 3rd Edition, 2009.
4. Nagrath, I.J. and Kothari.D.P., "Electric Machines", McGraw-Hill Education, 4th Edition, 2011.
5. Er.R.K.Rajput, "Electrical Machines ", Laxmi Publications, 6th Edition, 2016.
6. R.Srinivasan, "Special Electrical Machines", Lakshmi Publications, 2013.

WEB RESOURCES:

1. https://www.electricaleasy.com
2. https://www.electrical4u.com

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105131/
2. https://nptel.ac.in/courses/108/106/108106072/
3. https://www.sciencedirect.com
4. https://www.btechguru.com/engineering

OUTCOMES

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

1. Apply the concepts of synchronous generators to determine EMF, torque, power, and assess voltage regulation using standard methods. (K3)
2. Apply the working principles of synchronous motors to find torque, study characteristics, understand hunting, starting methods, and their use as a synchronous condenser.(K3)

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3. Analyze the construction and working of three-phase induction motors to interpret torque equations and assess performance characteristics under various operating conditions. (K4)
4. Analyze starting, speed control, and braking methods of three-phase induction motors for varying industrial needs. (K4)
5. Examine the behavior of single-phase induction motors using the double-field revolving theory and equivalent circuits. (K4)
6. Analyze the construction and operating principles of special machines to distinguish their functionalities. (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	1	1	2
CO2	2	1	1	-	-	-	-	-	-	-	1	1	2
CO3	2	2	2	-	-	-	-	-	-	-	1	1	2
CO4	2	1	1	-	-	-	-	-	-	-	2	1	2
CO5	2	2	2	-	-	-	-	-	-	-	2	1	2
CO6	2	1	2	-	-	-	-	-	-	-	2	1	2

SEMESTER - IV

24EEPC403 108105153 SDG NO. 4, 9, 11	MEASUREMENTS AND INSTRUMENTATION	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To introduce the fundamental concepts of measuring systems, their performance parameters and error analysis.
- To familiarize with the construction, working principles, and applications of various electromechanical instruments.
- To perform electrical measurements using DC and AC bridge networks and potentiometers.
- To introduce various types of transducers and their selection criteria for different applications along with display instruments.
- To impart knowledge about the working, advantages and usage of modern digital measurement instruments for practical applications.
- To provide exposure to smart instrumentation.

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PRE REQUISITES:

- Basic Circuit Theory

MODULE - I CONCEPTS OF MEASUREMENTS 7

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration.

MODULE - II ELECTROMECHANICAL INSTRUMENTS 8

Operating forces - Essentials of indicating instruments - Deflecting, damping, controlling torques - Moving Coil and Moving Iron Instruments - Single and three phase wattmeters - Instrument Transformers.

MODULE - III BRIDGES AND POTENTIOMETERS 8

D.C potentiometers and its applications - D.C Bridges -Wheat stone, Kelvin and Kelvin Double bridge - A.C bridges -Maxwell, Hay's and Schering bridges - Transformer ratio bridges - Self-balancing bridges.

MODULE - IV TRANSDUCERS AND DISPLAY INSTRUMENTS 8

Classification of transducers – Selection criteria- Resistive, Capacitive, Inductive, Piezoelectric and Hall effect transducers - CRT - Cathode Ray Oscilloscope (CRO) - Measurement of phase and frequency using Lissajous patterns - LED, LCD Display.

MODULE - V DIGITAL INSTRUMENTATION 7

Digital voltmeters - Digital multimeters - True RMS meters - auto-ranging meters - Digital energy meters - Digital frequency meter- Digital Storage Oscilloscope (DSO).

MODULE - VI SMART INSTRUMENTATION 7

Elements of a Data Acquisition System (DAS) - Data loggers - Case study on PC based measurement systems - Smart sensors - Wireless instrumentation.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", DhanpatRai and Co, 2023.
2. Rajput R.K., "Electrical and Electronic Measurements and Instrumentation", S.Chand and Co., Fourth Edition, 2016.

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REFERENCE BOOKS:

1. J. B. Gupta, "A Course in Electronic and Electrical Measurements", S. K.Kataria& Sons,14th Edition 2014, Reprint 2024.
2. Doebelin E.O. and Manik D.N., "Doebelin's Measurement Systems", McGraw Hill Education Pvt. Ltd., Sixth Edition, 2017.
3. D.V.S. Murthy, "Transducers and Instrumentation",Prentice Hall India Learning Private Limited, 2nd Edition 2008.
4. H.S. Kalsi, "Electronic Instrumentation and Measurements", McGraw Hill, Fourth Edition 2019.
5. Albert D. Helfrick, William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques" , Pearson, Edition 1, 2016.

WEB RESOURCES:

1. https://www.electricaleasy.com/2014/06/instrument-transformers-ct-and-pt.html
2. https://www.electrical4u.com/watt-hour-meter/
3. https://www.eeweb.com/digital-energy-meter/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108105153
2. https://onlinecourses.nptel.ac.in/noc25_ee82/preview
3. https://www.electricalandcontrol.com/types-of-sensors-used-in-measurement-and-process-control/
4. https://onlinecourses.nptel.ac.in/noc23_ee105/preview

OUTCOMES

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

1. Identify the factors affecting the performance of measuring systems like characteristics, standards, calibration and errors.(K3)
2. Apply the principles of electromechanical instruments for electrical measurements. (K3)
3. Utilize DC and AC bridges, potentiometers for electrical parameters estimation.(K3)
4. Apply the principles and selection criteria of various transducers and utilize CRO in measurement applications. (K3)
5. Apply the operating principles of digital instruments for accurate electrical measurements. (K3)

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6. Make use of Data Acquisition, Data logger, PC-based measurement systems, smart sensors and wireless instrumentation in measurement applications.(K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1
CO2	3	2	2	-	-	-	-	-	-	-	-	2	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1	1
CO4	3	2	2	-	-	-	-	-	-	-	2	1	1
CO5	3	2	2	-	-	-	-	-	-	-	2	1	1
CO6	3	2	2	-	-	-	-	-	-	-	2	2	2

SEMESTER - IV

24EIPC404 107106081 SDG NO. 4,9	CONTROL SYSTEMS	L	T	P	CP	C
		3	1	0	4	3

OBJECTIVES:

- To develop transfer function models for various physical systems using mathematical representations.
- To analyze time-domain and frequency-domain responses of control systems.
- To apply stability analysis techniques to determine system behavior.
- To design compensators for feedback systems using frequency-domain techniques.
- To develop state-space representations and analyze system properties using state-variable methods.
- To apply appropriate control strategies to meet system performance requirements.

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MODULE - I MATHEMATICAL MODELLING OF SYSTEM **8**

Open loop and closed loop systems - Physical system - Linear and Non-Linear systems Transfer function Mathematical modeling of Electrical and Mechanical systems Analogous systems - Block diagram representation - Signal flow graphs and their properties Mason's gain formula.

MODULE - II TIME DOMAIN ANALYSIS **8**

Standard test signals-Time response of first order and second order feedback control system to step input-Time domain specifications-Steady state error-Static error constants - Dynamic error coefficients - Introduction to P, PI, PID modes of feedback control.

MODULE - III FREQUENCY DOMAIN ANALYSIS **8**

Frequency domain specifications - Correlation between frequency domain and time domain specifications Bode plot - Polar plot - Determination of closed loop response from open loop response.

MODULE - IV STABILITY ANALYSIS **8**

Concepts of Stability: Necessary conditions for stability Routh Hurwitz stability criterion - Relative stability analysis. Root locus: Concepts of root - locus construction of root locus Determination of open loop gain for a specified damping of the dominant roots.

MODULE - V DESIGN OF FEEDBACK CONTROL SYSTEM **6**

Design specifications: Lead, Lag and Lag-Lead compensators using Bode plot techniques.

MODULE - VI STATE VARIABLE METHODS **7**

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability – Effect of state feedback

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Benjamin C. Ku and Farid Golnaraghi, "Automatic Control Systems", 10th edition McGraw-Hill Education, 2017.
2. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", 7th edition New Age International Publishers, 2017.

REFERENCES:

1. M.Gopal, "Control System–Principles and Design", Tata McGraw Hill,4th Edition, 2012.

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2. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education, 13th impression 2017
3. John J.D., Azzo Constantine, H. and Houpis Stuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor & Francis Reprint, 2014
4. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private ltd, PEARSON 5th edition 2015.
5. NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108106098/
2. https://nptel.ac.in/courses/108101037/

ONLINE RESOURCES:

1. https://lecturenotes.in/notes/15854-note-for-control-system-engineering-cse-by-amity-kumar
2. https://lecturenotes.in/notes/23763-note-for-control-system-engineering-cse-by-suman-kumar-acharya

OUTCOMES

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

1. Apply the mathematical modeling techniques to represent physical, mechanical, and electrical systems. (K3)
2. Apply time-domain analysis to a physical model system to compute steady-state and dynamic errors using error constants (K3)
3. Apply frequency-domain techniques such as Bode and polar plots to the transfer function model and relate the outcomes to time-domain behavior (K3)
4. Apply the Routh-Hurwitz criterion and Root Locus methods to evaluate system stability and gain margins. (K3)
5. Design lead, lag, and lag-lead compensators to satisfy specified performance requirements. (K4)
6. Analyze state-space representations of linear time-invariant systems to evaluate controllability, observability, and the impact of state feedback. (K4)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	1	2
CO2	3	-	-	-	-	-	-	-	-	-	-	1	2
CO3	3	-	-	-	-	-	-	-	-	-	-	1	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2	3
CO5	-	-	3	-	-	-	-	-	-	-	-	2	3
CO6	-	3	-	-	-	-	-	-	-	-	2	2	3

SEMESTER - IV

24HSNC401 - SDG NO. 4	NCC COURSE LEVEL 3	L	T	P	CP	C
		3	0	0	3	0

ARMY WING

PERSONALITY DEVELOPMENT **9**

PD 3 Group Discussion: Team Work 2

PD 4 Career Counselling, SSB Procedure & Interview Skills 3

PD 5 Public Speaking 4

BORDER & COASTAL AREAS **4**

BCA 2 Security Setup and Border/Coastal management in the area 2

BCA 3 Security Challenges & Role of cadets in Border management 2

ARMED FORCES 3

AF 2 Modes of Entry to Army, CAPF, Police 3

COMMUNICATION **3**

C 1 Introduction to Communication & Latest Trends 3

INFANTRY **3**

INF 1 Organisation of Infantry Battalion & its weapons 3

MILITARY HISTORY **23**

MH 1 Biographies of Renowned Generals 4

MH 2 War Heroes - PVC Awardees 4

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MH 3	Study of Battles - Indo Pak War 1965, 1971 & Kargil	9
MH 4	War Movies	6

TOTAL: 45 PERIODS

NAVAL WING

PERSONALITY DEVELOPMENT **9**

PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3

LEADERSHIP 7

L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7

DISASTER MANAGEMENT **13**

DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1

ENVIRONMENTAL AWARENESS & CONSERVATION **3**

EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS **4**

GA 1	General Knowledge	4

NAVAL ORIENTATION 6

AF 1	Armed Forces and Navy Capsule	3
EEZ 1	EEZ Maritime Security and ICG	3

ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

BORDER & COASTAL AREAS **2**

BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL: 45 PERIODS

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AIR FORCE WING		
PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Team Work	2
PD 4	Career Counselling, SSB Procedure & Interview Skills	3
PD 5	Public Speaking	4
BORDER & COASTAL AREAS		**4**
BCA 2	Security Setup and Border/Coastal management in the area	2
BCA 3	Security Challenges & Role of cadets in Border management	2
AIRMANSHIP		**1**
A 1	Airmanship	1
BASIC FLIGHT INSTRUMENTS		**3**
FI 1	Basic Flight Instruments	3
AERO MODELLING		**3**
AM 1	Aero Modelling Capsule	3
GENERAL SERVICE KNOWLEDGE		**2**
GSK 4	Latest Trends & Acquisitions	2
AIR CAMPAIGNS		**6**
AC 1	Air Campaigns	6
PRINCIPLES OF FLIGHT		**6**
PF 1	Principles of Flight	3
PF 2	Forces acting on Aircraft	3
NAVIGATION		**5**
NM 1	Navigation	2
NM 2	Introduction to Met and Atmosphere	3

TOTAL :45 PERIODS

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SEMESTER - IV

24EEPL401 - SDG NO. 4,8,9	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- Analyze and Design Control System Stability via Modeling and Simulation
- Understand and Apply Bridge Networks and Signal Conditioning Techniques
- Characterize Transducers and Measure Physical Variables with Instrumentation

LIST OF EXPERIMENTS:

CONTROL SYSTEM

1. P, PI, PID Controllers
2. Stability Analysis- Simulation by Mathematical Development Tools -Bode Plot, Root Locus
3. Modelling of Systems- Machines
4. Design of Lag, Lead, Lag-Lead Compensators
5. Position Control System
6. Synchro Transmitter -Receiver and Characteristics

INSTRUMENTATION

7. Bridge Networks-AC Bridges- De-Sauty Bridge, Maxwell Bridge
   DC Bridges- Wheatstone Bridge, Kelvin Bridge
8. Dynamics of Sensors / Transducers
   a. Temperature b.Displacement c. Strain d. Flow
9. Power and Energy Measurement
10. Signal Conditioning
    a. Instrumentation Amplifier b. Analog-Digital Converter
    c. Digital-Analog Converter

TOTAL : 60 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

CONTROL SYSTEM

1. PID Controller simulation and learner kit - 1 No
2. Digital Storage Oscilloscope - 1 Nos
3. DC Motor Generator setup - 1 No
4. CRO 30 MHZ - 2 Nos.

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5. DC Position control System Kit - 1 No
6. AC Synchro Transmitter & Receiver - 1 No
7. Digital multimeters - 5 Nos
8. Personal computers with control system simulation package - 10 Nos
9. Lag-Lead Compensator - 1 No
10. Voltmeter, Ammeter, Rheostat - 5 No.

MEASUREMENTS

1. R,L,C Bridge kit -4 Nos
2. Electric heater - 2 Nos
3. Thermistor, RTD Kit - 1 No.
4. LVDT 20mm core length movable type - 1 No.
5. Optical sensor - 1 No.
6. Strain Gauge Kit with Handy lever beam - 1 No.
7. 100gm weights - 10 Nos
8. Flow measurement Trainer kit -1 No
9. Energy meter - 1 No
10. Instrumentation Amplifier kit - 1 No
11. Analog - Digital converters -1 No

OUTCOMES

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

1. Understand and Apply control theory principles to analyze and solve electrical engineering problems involving converters and compensators. (K3)
2. Analyze the performance of first and second-order systems using time and frequency response. (K4)
3. Experiment various controllers (P, PI, PID) and evaluate their performance using simulation tool. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2	1	-	-	-	-	-	-	-	1	2
CO2	1	2	2	1	-	-	-	-	-	-	-	1	2
CO3	1	2	2	2	-	-	-	-	-	-	-	1	2

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SEMESTER - IV

24EEPL402 - SDG NO. 4, 7, 11	ELECTRICAL MACHINES LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To obtain the performance characteristics of DC motor
- To obtain the characteristics of DC generators
- To determine the performance of static machine
- To determine the regulation of synchronous generator
- To obtain the characteristics of a synchronous and induction motor.
- To find the equivalent circuit parameters of three-phase induction motor

LIST OF EXPERIMENTS:

1. Open circuit and load characteristics of DC shunt generator - critical resistance and critical speed
2. Load characteristics of DC compound generators with differential and cumulative connections
3. Load test on DC shunt motor
4. Hopkinson's test on DC motor – generator set
5. Load test on single phase transformer
6. Sumpner's test on single phase transformers.
7. Regulation of three phase alternators by EMF and MMF methods.
8. Regulation of three phase alternator by ZPF and ASA methods
9. V and Inverted V curves of Three Phase Synchronous Motor.
10. Load test on three-phase induction motor.
11. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).

TOTAL : 60 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1. DC Shunt Motor with Loading Arrangement – 3nos
2. Single Phase Transformer – 4nos
3. DC Series Motor with Loading Arrangement – 1 No.
4. DC compound Motor with Loading Arrangement – 1 No.
5. DC Shunt Motor Coupled With DC Compound Generator – 2nos
6. DC Shunt Motor Coupled With DC Shunt Generator – 2nos
7. Tachometer -Digital/Analog – 8nos

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8. Single Phase Auto Transformer – 4 nos
9. Single Phase Resistive Loading Bank – 2nos
10. DC Shunt Motor Coupled With Three phase Alternator – 4nos
11. Three Phase Induction Motor with Loading Arrangement – 2nos
12. Single Phase Induction Motor with Loading Arrangement – 2nos
13. Three Phase Auto Transformer – 3nos
14. Three Phase Resistive Loading Bank – 2nos

OUTCOMES

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

1. Analyze the performance of DC Motor by conducting direct and indirect tests. (K4)
2. Categorize the performance of DC Generator by conducting direct and indirect tests(K4)
3. Examine the performance of transformers by conducting direct and indirect tests. (K4)
4. Inspect the regulation of synchronous generator (K4)
5. Distinguish the performance characteristics of synchronous and induction motor (K4)
6. Simplify the equivalent circuit parameters of induction motor (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	1	-	-	-	1	-	-	-	2
CO2	2	1	2	2	1	-	-	-	1	-	-	-	2
CO3	2	1	1	2	-	-	-	-	1	-	-	-	2
CO4	2	1	1	1	-	-	-	-	-	-	-	-	1
CO5	2	1	1	2	-	-	-	-	-	-	-	-	1
CO6	1	1	1	1	-	-	-	-	-	-	-	-	1

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SEMESTER - IV

24EETP401 - SDG NO. 4	APTITUDE SKILLS - II	L	T	P	CP	C
		0	0	2	2	0

PROBLEM SOLVING TECHNIQUES USING C PROGRAMMING – PHASE 1

OBJECTIVES:

- Build a strong foundation in C programming concepts and problem-solving techniques.
- Develop the ability to write efficient and modular code.
- Enhance understanding of data structures, memory management, and algorithms for optimized solutions.

MODULE - I FOUNDATIONS OF PROGRAMMING 12

- Understanding Programming Languages: Why they are essential and their various types.
- Operators in C: Exploring assignment, arithmetic, relational, and logical operators.
- Tokens and Identifiers: Learning about keywords, naming conventions, and best practices.
- Control Structures in C: Choosing the right structure for efficient programming:
- Selective Control (Decision-making statements)
- Iterative Control (Loops for repetition)
- Unconditional Control (Jump statements)

MODULE - II DATA TYPES, NUMBER SYSTEMS AND FUNCTIONS 12

- **Operators in Depth:** Understanding increment, decrement, and short-circuit operators.
- **Number Systems & Conversions:** Mastering different number systems, conversions, and format specifiers.
- **Data Types in C:** Exploring signed and unsigned types (int, float, char) and their usage.
- **Functions in C:**
- Importance of modular programming.
- Writing and using functions effectively.

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MODULE - III POINTERS, ARRAYS, AND PROBLEM-SOLVING **21**

- **Pointers in C:**
- Understanding memory management.
- How pointers enable direct hardware communication.
- **Arrays in C:**
- Efficiently storing multiple elements.
- Single-dimensional and multi-dimensional arrays.
- **Problem-Solving Techniques:**
- Tackling challenges related to arrays and strings.
- Optimizing algorithms for efficiency.

TOTAL: 45 PERIODS

REFERENCES:

1. Let Us C – Yashavant Kanetkar - 16th Edition: 2017.
2. Programming in ANSI C – E. Balagurusamy-9th Edition: July 11, 2024.
3. The C Programming Language – Brian W. Kernighan and Dennis M. Ritchie - Second Edition (ANSI C): April 1988.
4. C: How to Program – Paul Deitel and Harvey Deitel - 9th Edition: March 27, 2024
5. Problem Solving and Program Design in C – Jeri R. Hanly and Elliot B. Koffman - 8th Edition exists with ISBN 978-0-13-401490-0

PHASE 2

(LIFE SKILLS, RANGER AND ROVER & BIS STANDARDS)

OBJECTIVES:

- Explore core domain BIS standards related to Insulators, Cables and Power Capacitors.
- Implement strategies to learn career and managerial skills for career growth.

MODULE - I JEEVAN KAUSHAL 2.0 – CAREER SKILLS AND MANAGERIAL SKILLS **14**

Group Discussion Skills - Meaning and Methods of Group Discussion - Procedure of Group Discussion - Group Discussion - Simulation - Group Discussion - Common Errors.

Managerial Skills - Basic Managerial Skills - Planning for effective management - How to organize teams? - Recruiting and retaining talent - Delegation of tasks - Learn to coordinate - Conflict management - Self-management Skills - Understanding self-concept - Developing self- awareness - Self-examination - Self-reflection and Introspection - Self- regulation.

Entrepreneurial Skills - Basics of Entrepreneurship - Meaning of

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entrepreneurship – Classification and types of entrepreneurships - Traits and competencies of entrepreneur -. Creating Business Plan - Problem identification and idea generation - Idea validation - Pitch making.

Managing Personal Finance - Budgeting - Setting personal goals - Estimate likely expenses Monitor spending to obtain the most value for the available funds - Saving and Investing - Advantages of saving money - Concept of present and future value of money.

MODULE - II RANGER AND ROVER **10**

Scouting for Boys: Scout Craft, Campaigning.

Knots: Managing of rope, types of ropes and uses, Basic Knots: - Clove Hitch, Reef Knot, Fisherman knot, Sheet bend, Bowline, Sheep shank, whippings.

Growing Together: Understanding the growth context.

Intergenerational Dialogue: How to enhance learning and cooperation across generations.

MODULE - III INDIAN STANDARDS ON INSULATORS, CABLES AND POWER CAPACITORS **6**

Insulators: Design characteristic of Overhead Insulators and overview of faults in transmission system. **Cables:** Introduction to selection, design and testing of Cables in distribution and transmission system. **Power Capacitors:** Working principle, Classification of Power Capacitors, Test methods, Indian Standards available on various types of Power Capacitors.

TOTAL: 30 PERIODS

REFERENCES:

1. Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0, UGC, New Delhi.
2. A World Built on Standards: A Textbook for Higher Education, Published by: Danish Standards Foundation, 2015.
3. SO / IEC Guide 59, BIS Standards Formulation Manual, 2nd Revision, 2022.

ONLINE RESOURCES

1. https://lms.scout.org/courses/show/214175?force_course_hub=true
2. https://lms.scout.org/courses/show/214194?force_course_hub=true
3. https://www.ugc.gov.in/pdfnews/4874522_Draft-Curriculum-for-Life-SKill-Jeevan-Kaushal.pdf (ugc.gov.in)

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OUTCOMES

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

1. Understand and apply the fundamentals of C programming for problem-solving. (K2)
2. Utilize control structures, operators, and functions to write modular programs. (K2)
3. Implement pointers and arrays for efficient memory and data management. (K2)
4. Solve real-world problems by designing and optimizing algorithms. (K2)
5. Demonstrate career and managerial skills. (K2)
6. Summarize BIS standards for various electrical components. (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	2	2	-
CO2	2	2	2	2	1	-	-	-	1	-	2	2	-
CO3	2	2	2	2	-	-	-	-	1	-	2	2	-
CO4	2	2	2	2	1	-	-	-	1	-	2	2	-
CO5	-	-	-	-	-	3	-	-	1	-	2	-	2
CO6	2	-	2	2	2	2	-	-	-	-	2	2	2

SEMESTER - IV

24EEID401 - SDG NO. 4,11,15	INNOVATIVE DESIGN LAB - II	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To empower students to transform innovative ideas into viable venture blueprints through structured entrepreneurial exploration and opportunity framing.
- To provide experiential learning in adaptive product evolution by focusing on user-centric redesign, iterative testing, and technical refinement.
- To develop proficiency in assessing market traction, decoding customer behavior, and aligning product strategy with investment-readiness metrics.
- To instill a foundation of ethical entrepreneurship by integrating inclusive design principles, sustainability values, and responsible leadership.

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- To enable data-driven innovation by leveraging field research, applying performance analytics, and integrating emerging technologies for solution optimization.
- To facilitate multidisciplinary problem-solving through advanced engineering integration, MVP systemization, and standards-compliant validation.

COURSE METHODOLOGY:

1. This initiative is designed to inculcate ethical principles of research and to get involved in a life-long learning process for the students, focusing on the practical execution and refinement of entrepreneurial ventures.
2. The project work must involve the continuous development, iterative enhancement, and potential launch of an entrepreneurial solution. It must also include appropriate elements of the following: compliance with advanced engineering standards, iterative design analysis, enhanced prototyping, robust experimentation, real-world user feedback collection, data correlation, and advanced software/hardware development for the solution.
3. Projects can be individual work or group projects, with a maximum of Three students. In case of a group project, each student must submit an individual project report clearly specifying their unique contributions to the collective work.
4. On completion of the project, the student shall submit a detailed project report encompassing the evolution of their venture, technical implementation, market validation, and future roadmap. The project shall undergo a formal review process, after which the report will be evaluated. Students shall appear for a mandatory viva-voce examination on the project, approved jointly by the Coordinator and the respective project guide.

EVALUATION:

1. First evaluation (Immediately after first internal examination): 20 marks (Focus on refined problem statement, advanced MVP design, and detailed development plan)
2. Second evaluation (Immediately after second internal examination): 30 marks (Focus on prototype/MVP implementation, initial testing, and preliminary market validation results)
3. Final evaluation (Last week of the semester): 50 marks (Focus on the complete refined solution, comprehensive market validation, growth strategy, final project report, and viva-voce)

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Note: All three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

1. Apply structured entrepreneurial exploration to convert innovative ideas into venture blueprints, incorporating user-centric and iterative design approaches. (K4)
2. Assess customer behavior and market traction to align product strategies with ethical and sustainable entrepreneurship principles. (K5)
3. Integrate multidisciplinary knowledge, field data, and emerging technologies to optimize and validate engineered solutions. (K6)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	2	-	-	-	2	2
CO2	3	3	2	-	-	-	-	2	-	-	-	2	2
Co3	3	3	2	-	-	-	-	2	-	-	-	2	2

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SEMESTER V

COURSE CODE: 24EEPC501	POWER SYSTEM ANALYSIS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117105140	SYLLABUS VERSION 1.0	SDG NO. 4, 7				
PRE-REQUISITE COURSES	24EEPC401					

OBJECTIVES:

- To model the power system under steady state operating conditions.
- To apply efficient numerical methods to solve the power flow problems.
- To model and carry out short circuit studies on power systems.
- To model and analyze stability problems in power systems.
- To perform computational analysis using practical power system data.

MODULE - I POWER SYSTEM REPRESENTATION 7

Power system planning and operational objectives -Modeling of synchronous generators, transformers and transmission lines-Single line diagram of a typical power system- Per unit system - Impedance and reactance diagram.

MODULE - II POWER FLOW ANALYSIS 8

Importance of power flow analysis-Bus classification –Load flow solutions – Gauss-Seidel method – Handling of Voltage controlled buses - Newton-Raphson method.

MODULE - III SYMMETRICAL FAULT ANALYSIS 8

Assumptions in short circuit analysis- Types of faults – Short circuit current calculation using Thevenin's theorem and bus impedance matrix – Short circuit capacity – Selection of circuit breakers.

MODULE - IV UNSYMMETRICAL FAULT ANALYSIS 8

Symmetrical components – Sequence impedances – Sequence network of power system components: synchronous machines, transmission line, transformer and loads – Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG.

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MODULE - V STABILITY ANALYSIS **8**

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

MODULE - VI COMPUTATIONAL ANALYSIS- CASE BASED APPROACH **6**

Load flow analysis using standard test system data- Short Circuit analysis using utility-type network data- Unsymmetrical fault analysis using recorded phase data.

TOTAL : 45 PERIODS

TEXT BOOK:

1. John J. Grainger, William D. Stevenson, Jr, "Power System Analysis",Mc Graw Hill Education (India) Private Limited, New Delhi, 2017.
2. Nagrath I.J., Kothari D.P. "Modern Power System Analysis", Fourth Edition, Tata Mc Graw Hill Publishing Company, New Delhi, 2011.

REFERENCES:

1. Pai M.A. "Computer Techniques in Power System Analysis", Tata Mc Graw Hill Publishing Company, New Delhi, 2003.
2. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Education Pvt.Ltd., New Delhi, 21st reprint, 2010.
3. Abhijit Chakrabarti,Sunita Halder,"Power System Analysis Operation and Control",PHI Learning Private Limited, New Delhi, 2011.
4. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, "Power System Analysis & Design", Fifth Edition, Cengage Learning India Private Limited , 2012.
5. Gupta B.R., "Power System Analysis and Design", Eighth Edition, S. Chand & Co.Publishing Ltd, New Delhi, 2011.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108105067/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2353/power-systems-analysis

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OUTCOMES

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

1. Examine the mathematical model of a given power system network.(K4)
2. Analyze the performance of numerical techniques used for power flow analysis.(K4)
3. Investigate the power system network under symmetrical fault Conditions and select the circuit breaker ratings.(k4)
4. Interpret symmetrical component theory to analyze unsymmetrical faults in power systems.(k4)
5. Evaluate power system stability using swing equations and estimate system response under transient conditions. (k4)
6. Analyze real-time power system case studies using standard test systems based on analytical and numerical techniques.(K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	-	1	-	-	-	-	-	-	-	1	-
CO3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO4	2	1	1	1	-	-	-	-	-	-	-	1	-
CO5	2	1	-	-	-	-	-	-	-	-	-	1	-
CO6	2	3	1	2	1	-	-	-	-	-	-	1	1

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SEMESTER V

COURSE CODE: 24EEPC502	POWER ELECTRONICS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108102584	SYLLABUS VERSION 1.0	SDG NO. 4, 7				
PRE-REQUISITE COURSES	24EEPC201, 24EEPC303					

OBJECTIVES:

- To Provide fundamental knowledge of power semiconductor devices, and emerging wide band gap devices (SiC and GaN).
- To study the operation, control, and performance analysis of single-phase and three-phase phase-controlled rectifiers, including the effect of source inductance and dual converter operation.
- To introduce the principles and control strategies of DC–DC converters (choppers) and switched-mode power regulators such as buck, boost, and buck–boost converters.
- To develop an understanding of single-phase and three-phase inverters, their modes of operation, and PWM techniques for improved output voltage control.
- To familiarize students with the operating principles and control methods of AC–AC converters, including AC voltage controllers and cyclo-converters.
- To Provide hands-on exposure to the simulation of power electronic converters using MATLAB and relate theoretical concepts to practical applications such as electric vehicles (Evs).

MODULE - I POWER SEMICONDUCTOR DEVICES 7

Static V-I characteristics and dynamic characteristics of power diodes, power MOSFET, IGBT, SCR, firing/gating circuits of SCR, commutation techniques, Introduction to SiC and GaN devices, Introduction to power modules.

MODULE - II PHASE CONTROLLED RECTIFIERS 9

Single phase uncontrolled and controlled rectifiers, performance parameters, Effect of source inductance, single phase dual converters, Three phase uncontrolled and controlled rectifiers, Three phase Dual converters

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MODULE - III DC-DC CONVERTERS 7

Introduction to Choppers, Control strategy, Introduction to types of choppers- A, B, C, D,E choppers, Switched mode regulators- Buck, Boost, Buck- Boost regulator

MODULE - IV INVERTERS 7

Single phase and three phase voltage source inverters (both120 degree mode and 180 degree mode), PWM techniques: Single pulse, Multiple pulse , Sinusoidal. Introduction to current source inverter.

MODULE - V AC-AC CONVERTERS 7

Single phase and Three phase AC voltage controllers, Control strategy, Multistage sequence control, Single phase and three phase cyclo-converters. Introduction to matrix converter.

MODULE - VI SIMULATION OF POWER CONVERTERS 8

Simulation of single phase and three phase rectifiers, DC converters, Inverters, AC voltage regulators using MATLAB.

TOTAL : 45 PERIODS

TEXT BOOK:

1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, New Delhi, 4th Edition, 2017.
2. P. S. Bimbhra, 'Power Electronics',Khanna Publishing House, New Delhi, 7th Edition, 2022.

REFERENCES

1. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2003.
2. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.
4. Ned Mohan, Tore M. Undel, William P. Robbins, "Power Electronics: Converters, Applications, and Design", John Wiley and sons Publication, 3rd Edition, 2010.
5. M. D. Singh and K. B. Khachandani, "Power Electronics", McGraw-Hill Education, 2nd Edition, 2017.

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6. L. Umanand, "Power Electronics: Essentials & Applications", Wiley India, 1st edition 2009.

WEB RESOURCES:

1. https://www.electrical4u.com/electrical-engineering-articles/power-electronics/
2. https://www.electronicsforu.com/technology-trends/learn-electronics/understanding-power-electronics

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105066/#
2. https://www.sciencedirect.com/topics/materials-science/power-electronics
3. https://www.coursera.org/specializations/power-electronics
4. https://onlinecourses.nptel.ac.in/noc21_ee01/preview
5. https://nptel.ac.in/courses/108/102/108102046/

OUTCOMES

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

1. Analyze the static and dynamic characteristics of power semiconductor devices such as diodes, MOSFETs, IGBTs, SCRs, and explain the operating principles of SiC and GaN devices.(K4)
2. Infer the operation and performance of single-phase and three-phase uncontrolled and controlled rectifiers, including the effect of source inductance and dual converter operation. (K4)
3. Discuss the operation of Class A to E choppers and examine the Switched mode Regulators such as Buck, Boost, and Buck-Boost Regulators.(K4)
4. Illustrate the single and three phase voltage source inverter , current source inverters, voltage control, Voltage& harmonic control--PWM techniques: Single, Multiple PWM, Sinusoidal PWM(K3)
5. Implement the single and three phase AC voltage controllers, Multistage sequence control, cyclo converter using power semiconductor devices(K3)
6. Analyze the working of above power converters through simulation (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	2	2	1
CO2	3	3	3	-	-	-	-	-	-	-	2	2	2
CO3	2	3	3	2	1	-	-	-	-	-	2	2	2
CO4	2	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	-	-	-	-	-	-	-	-	2	2	2
CO6	2	2	3	3	3	-	-	-	-	2	3	2	2

SEMESTER V

COURSE CODE: 24MGMC501	CONSTITUTION OF INDIA	L	T	P	CP	C
		2	0	0	2	0
NPTEL CODE: -	SYLLABUS VERSION 1.1	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To know about Indian constitution.
- To know about central government functionalities in India.
- To know about state government functionalities in India.
- To know about Constitution function.
- To Know about Constitutional remedies

MODULE - I INTRODUCTION 5

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties.

MODULE - II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 5

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India.

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MODULE - III STRUCTURE AND FUNCTION OF STATE GOVERNMENT 5

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

MODULE - IV CONSTITUTION FUNCTIONS 5

Indian Federal System – Centre – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries.

MODULE - V CONSTITUTIONAL REMEDIES 5

Enforcement of fundamental rights - Power of parliament to modify the rights the conferred by this part in their application to forces.

MODULE - VI CONSTITUTIONAL GOVERNANCE IN THE DIGITAL ERA AND CONTEMPORARY ISSUES 5

Constitutional Values and Good Governance – Right to Information (RTI) and Citizen Participation – Digital Governance and e-Governance Initiatives in India – Constitutional Perspectives on Artificial Intelligence (AI) and Emerging Technologies.

TOTAL : 30 PERIODS

TEXT BOOKS:

1. Durga Das Basu, Introduction to the Constitution of India, 27th Edition (2024), LexisNexis Butterworths Wadhwa.
2. M. V. Pylee, An Introduction to the Constitution of India, Latest Revised Edition (2024), Vikas Publishing House.
3. P. M. Bakshi, The Constitution of India, 18th Edition (2025), Universal LexisNexis
4. Brij Kishore Sharma, Introduction to the Constitution of India, 15th Edition (2024), PHI Learning

REFERENCE BOOKS:

1. D. D. Basu, Shorter Constitution of India, Latest Revised Edition, LexisNexis
2. Subhash C. Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law, Latest Edition, National Book Trust
3. M. Laxmikanth, Indian Polity, 7th Edition (2025), McGraw Hill Education

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4. J. N. Pandey, Constitutional Law of India, Latest Edition (2024), Central Law Agency.
5. V. N. Shukla, Constitution of India, Revised by Mahendra Pal Singh, 14th Edition / Latest Available Edition, Eastern Book Company

ONLINE REFERENCES

1. https://iasexamportal.com/ebook/the-constitution-of-india
2. https://eclass.cc/courses/udemy_basics_of_indian_constitution_a_refresher_course
3. https://ox.libguides.com/c.php?g=422964&p=2888489
4. https://mylaw.net/litigation/constitutional-law-course
5. www.tutorialspoint.com/indian_polity/indian_polity_sources_consitution.htm
6. www.drishtiias.com/gs-special/gs-special-polity/important-sources-of-the-indian-constitution
7. www.india.gov.in/my-government/constitution-india/constitution-india-full-text
8. http://legislative.gov.in/constitution-of-india

MOOC REFERENCES

1. https://www.mooc-list.com/tags/law
2. https://www.udemy.com/course/polity-and-constitution/
3. https://swayam.gov.in/nd2_cec19_hs13/preview
4. https://www.udemy.com/course/basics-of-indian-constitution-a-refresher-course/

OUTCOMES:

At the end of this course, the students should be able to:

1. Explain the historical evolution, philosophy and fundamental principles of the Constitution of India. (K2)
2. Describe the structure, powers and functions of the Union Government under the Constitution. (K2)
3. Interpret the structure and functioning of State Governments and the judicial system in India. (K2)
4. Analyze federal relations, constitutional amendments and constitutional functionaries. (K4)

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5. Examine constitutional remedies and mechanisms for protection of fundamental rights. (K4)
6. Apply constitutional values and principles to contemporary governance, digital rights, AI ethics and emerging societal challenges. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	1	-	-	-	2	1	2	-	-	-	2	2
CO2	-	2	-	-	-	2	2	2	-	-	-	2	2
CO3	-	2	-	-	-	2	2	2	-	-	-	2	2
CO4	-	2	1	-	-	2	2	2	-	-	-	2	2
CO5	-	2	1	-	-	2	2	2	-	-	-	2	2
CO6	-	2	1	-	-	2	2	2	-	-	-	2	2

SEMESTER V

COURSE CODE: 24EEPL501	POWER ELECTRONICS LABORATORY	L	T	P	CP	C
		0	0	4	4	2
NPTEL CODE: 117105140	SYLLABUS VERSION 1.0	SDG NO. 4, 7				
PRE-REQUISITE COURSES	24EEPL301					

OBJECTIVES:

- To familiarize the operation and characteristics of various switching devices with experimental results.
- To familiarize the operation of various types of converters with simulation and experimental results.
- To familiarize the operation of Chopper, Inverter and AC Voltage controller with simulation and experimental results.
- To familiarize the operation of Cyclo converters.

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LIST OF EXPERIMENTS:

1. Steady state characteristics of SCR, TRIAC, and IGBT.
2. Experimental verification of Single phase semi and full converters
3. Experimental verification Step down and Step up MOSFET based choppers
4. Experimental verification of Switched Mode Regulators converters
5. Experimental verification of Inverters.
6. Experimental verification AC voltage regulators.
7. Simulation of 1Φ & 3Φ converters.
8. Simulation of DC-DC converters.
9. Simulation of AC voltage controllers.
10. Simulation of 1Φ & 3Φ inverters.
11. Simulation of 1Φ cycloconverters.
12. Design of Driver circuits

TOTAL : 60 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1. SCR, TRIAC, MOSFET and IGBT kit with built-in / discrete power supply and meters - 2 each
2. Single phase SCR based half controlled converter and fully controlled converter along with built-in/separate/firing circuit/module and meter – 2 each
3 MOSFET based step up and step down choppers (Built in/ Discrete) – 1 each
4. IGBT based single phase PWM inverter module/Discrete Component –2
5. IGBT based three phase PWM inverter module/Discrete Component –2
6. Switched mode power converter module/Discrete Component –2
7. SCR &TRIAC based single phase AC controller along with lamp or rheostat load -2
8. Dual regulated DC power supply with common ground
9. Cathode ray Oscilloscope–10
10. Isolation Transformer –3
11. Single phase Auto transformer–3
12. Components (Inductance, Capacitance) 3 set for each
13. Multimeter –5
14. Rheostats of various ranges – 2 sets for each value
15. DC and AC meters of required ranges –20
16. Standalone PC with MATLAB software installed – 10

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Component data sheets to be provided

OUTCOMES

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

1. Demonstrate the characteristics of power switching devices and operation of phase-controlled converters and DC-DC converters with customer requirements. (K3)
2. Examine the chopper and inverter for applications extended to automobile applications. and the operation of AC voltage controllers, driver circuit for the semiconductor switching devices for a particular application (K4)
3. Critique the operation of a single-phase cycloconverter in simulation. (K5)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	3	3	-	-	-	-	-	-	3	3
CO2	2	2	2	3	3	-	-	-	-	-	-	3	3
CO3	2	2	2	3	3	-	-	-	-	-	-	3	3

SEMESTER V

COURSE CODE: 24EEPT501	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: 117105140	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ESMC301, 24EEPC304, 24ESPL101					

OBJECTIVES:

- To understand the architecture, programming of microprocessors and microcontrollers
- To program the 8051 microcontroller by effectively using SFRs, timers, interrupts, and I/O ports.
- To learn interfacing techniques and peripheral device management
- To bridge the theoretical knowledge with practical applications.

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MODULE - I INTRODUCTION TO MICROPROCESSOR 7

Architecture and features of microprocessor (8085). Instruction Set and Addressing modes of 8085.

List of Experiments

1. Basic arithmetic and Logical operation using 8085
2. Programs using Rotate instructions.
3. Hex / ASCII / BCD code conversions..

MODULE - II INTERFACING PERIPHERALS 7

Architecture and programming of IC's - 8255, 8279, ADC, DAC

List of Experiments

1. Traffic light controller.
2. keyboard and display interfacing
3. ADC and DAC interfacing

MODULE - III 8051 MICROCONTROLLER 7

Architecture and features of microprocessor (8051). Instruction Set and Addressing modes of 8051, Memory organization of 8051 and Timers

List of Experiments

1. Basic arithmetic and Logical operation using 8051
2. Programming – (i)Conditional jumps & looping (ii) Calling subroutines.

MODULE - IV INTERFACING TECHNIQUES 8

Interfacing stepper motor, ADC & DAC.

List of Experiments

1. Stepper motor Interfacing Interface stepper motor and control speed and direction
2. Study on interface with A/D & D/A
3. Study on interface with DC & AC motors.

MODULE - V INTRODUCTION TO ARM 8

ARM Architecture Versions, Instruction Set, Features of the LPC214X Family.

List of Experiments

1. Write a program to find the largest or smallest number in an array of 32 bit numbers.
2. Write a program to arrange a series of 32 bit numbers in ascending/descending order.

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3. Write an Assembly Language Program (ALP) to i) Multiply two 16-bit numbers. ii) Add two 32-bit numbers.

MODULE - VI ARM FEATURES **8**

TIMER, ADC, DAC, UARTs and MEMORY CARD INTERFACING

List of Experiments

1. Temperature indication on an RGB LED.
2. Take analog readings on rotation of rotatory potentiometer connected to an ADC channel.
3. Interfacing keyboard and LCD 4x4 Keyboard interface with ARM

TOTAL : 45 PERIODS

TEXT BOOK:

1. R.S. Gaonkar, 'Microprocessor, Architecture, Programming and application with 8085, Prentice Hall, Fifth Edition, 2002 and Penram International Publishing -Asian Edition
2. Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
3. Muhammad Tahir and Kashif Javed, 'ARM microprocessor Systems - Cortex-M Architecture, Programming, and Interfacing', CRC Press, 2011

REFERENCES

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu, Third edition, 2017.
3. RM Assembly Language Programming & Architecture (Mazidi & Naimi ARM) 2.0 Edition Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc26_ee58/preview
2. https://nptel.ac.in/courses/106105193

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WEB RESOURCES:

1. https://www.embedded.com
2. https://www.electrical4u.com/embedded-systems
3. https://www.engineersgarage.com/embedded-systems

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	8085 Microprocessor Trainer with Power Supply	15
2.	8051 Micro Controller Trainer Kit with power supply	15
3.	8255 Interface boards	5
4.	8279 Keyboard / Display Interface boards	5
5.	8254 timer/ counters	5
6.	ADC and DAC cards	5
7.	AC & DC motor with Controller s	5
8.	Traffic light controller	5
9.	LPC2148 ARM trainer kit	10

OUTCOMES

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

1. Differentiate the architectural features, instruction set, and operational cycles of the Intel 8085 Microprocessor to interpret system behavior . (K4)
2. Investigate and debug assembly language programs of the 8085 microprocessor to identify logical and computational errors (K4)
3. Examine the functional units, instruction sets and timers of the 8051 Microcontroller to interpret embedded system design (K4)
4. Categorize embedded programs and interfacing techniques of the 8051 microcontroller to analyze real-time applications . (K4)
5. Distinguish the architecture, pipeline stages, and instruction execution of ARM Cortex Processor to infer system performance (K4)
6. Compare ARM-based program execution and peripheral interfacing techniques to evaluate system functionality (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	1	-	-	-	-	-	-	-	-	-	1	1
CO4	3	2	-	-	1	-	-	-	-	-	-	2	1
CO5	3	1	-	-	-	-	-	-	--	1	1	1	1
CO6	3	2	-	-	1	-	-	-		1	1	3	2

SEMESTER V

COURSE CODE: 24EETP501	SKILL ENHANCEMENT	L	T	P	CP	C
		0	0	2	2	1
NPTEL CODE: -	SYLLABUS VERSION 1.1	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24EETP301, 24EETP401					

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Educate and enrich students on quantitative ability, reasoning ability, and verbal ability.
- Build a strong foundation for solving recruitment-based problems with speed and accuracy.
- Enhance creative thinking skills.
- Enhance logical problem-solving skills.

MODULE - I QUANTITATIVE ABILITY 22

Number Properties, Speed Math, HCF and LCM, Percentages, Time and Work, Time Speed and Distance, Ratio Proportion and Variations, Averages Mixtures and Alligation

MODULE - II QUANTITATIVE ABILITY REASONING ABILITY 16

Profit and Loss, Simple Interest and Compound Interest, Blood Relation, Directions, Coding and Decoding, Series, Ranking and Arrangements

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MODULE - III VERBAL ABILITY 7

Subject-Verb Agreement, Tenses, Prepositions - Concepts, Error Spotting, Sentence Correction, Fill in the Blanks

TOTAL : 45 PERIODS

REFERENCES

1. Quantitative Aptitude for Competitive Examinations – R.S. Aggarwal
2. A Modern Approach to Logical Reasoning – R.S. Aggarwal
3. High School English Grammar & Composition – Wren & Martin
4. Word Power Made Easy – Norman Lewis.
5. Fast Track Objective Arithmetic – Rajesh Verma

BIS STANDARDS, RANGER AND ROVER, LIFE SKILLS – PHASE 2

OBJECTIVES

To enable students to,

- Familiarize the team and leadership skills.
- Understand the standards relevant to EEE.

MODULE - I JEEVAN KAUSHAL 2.0 - COGNITIVE SKILLS, INNOVATIVE LEADERSHIP AND DESIGN THINKING, ETHICS AND INTEGRITY 14

Cognitive and Non-cognitive Skills - Cognitive Skills: Meaning, Types of Cognitive Skills, Strategies to Develop Cognitive Skills- Critical Thinking Skills- Problem-solving skills - Ability to Learn, Non-cognitive Skills: Meaning and Types of Non-cognitive Skills, Strategies to Develop Non-cognitive Skills- Empathy- Creativity- Teamwork- Collaboration- Resilience - Interpersonal Skills- Perseverance- Social Control- Social Skill, Peer Pressure – Stress and Stress Management.

Innovative Leadership and Design Thinking- Concept of emotional and social intelligence, Concept of emotional and social intelligence, Innovative Leadership- Synthesis of human and artificial intelligence, Why does culture matter for today's global leaders? Design Thinking- What is design thinking?, Key elements of design thinking, How to transform challenges into opportunities?, How to develop human-centric solutions for creating social good?

Ethics and Integrity - Learning through Biographies - What makes an individual great?, Understanding the persona of a leader for deriving holistic inspiration, Drawing insights for leadership, How leaders sail through difficult situations? Ethics and Conduct - Importance of ethics, Ethical decision making, Personal and professional moral codes of conduct, creating a harmonious life

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MODULE - II RANGER AND ROVER **10**

Scouting for Boys: Camp Life, Trekking Wood Craft.

Community Service: Meaning, Types of Community Service & duration, difference between Community Service and Community Development.

WOSM / WAGGGS / Govt. of India Initiatives (One Event At least) - Surf Smart, Free Being Me, Messengers of Peace, Scouts of the World Award

Messengers of Peace and Scouts

MODULE - III INDIAN STANDARDS ON POWER CONVERTERS & UPS, LOW VOLTAGE AND HIGH VOLTAGE SWITCHGEARS, HIGH VOLTAGE DIRECT CURRENT **6**

Power Converters & UPS : Introduction to Power Electronics -Fundamentals of Power Electronics-Definition and scope of power electronics, Basic power electronic components - Review of Relevant IS/IEC Standards - Power Supplies: IS/IEC 61204 series- low-voltage switch-mode power supplies - IS 15199 (Part 1 & 2): Power convertors installed on board rolling stock (railway)-IS 16242 (Part 1, 2 & 3): General, safety, EMC, and performance requirements for UPS - Adjustable Speed Drives: IS 17123 (Part 1 & 6): General requirements and load duty determination for adjustable speed drives-IS/IEC 61800 series- Adjustable Speed Electrical Power Drive Systems.

Low Voltage and High Voltage Switchgears: Characteristic and performance requirements of Low voltage and High voltage switchgears such as circuit breakers, switches, starters etc

High Voltage Direct Current Foundational Concepts of High-Voltage Direct Current (HVDC) Systems-Introduction to Standards and Key HVDC Terminology- IEC and IS Organizations: Explain their roles in developing standards-Vocabulary (from IS 14801)- IS 14902 (Part 1,2,3): Steady-state, faults/switching, dynamic conditions Power Losses - IS 15597: Determination of losses AC Filtering and Reactive Power-IS 16071 (Part 1-4): AC filter design, performance, modeling, equipment Voltage-Sourced Converter (VSC) Systems- IS 16075: VSC valve electrical testing-IS 16667: Application of active filters-IS 16666: HVDC substation audible noise-IS 17575: VSC power transmission (general)-IS 18322 (Part 1-2): VSC valve power losses System Design, Testing, and Performance-IS 16076: System tests Asset Management, Reliability, and Environment-IS 17576: Electromagnetic performance of overhead lines-IS 17577: Asset management guidelines-IS 17578: Reliability and availability evaluation -IS 18324: Design of earth electrode stations Other topics (FACTS, UPFC, etc.)-IS 18321: Unified Power Flow Controller (UPFC)

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performance- IS 18322: Thyristor-controlled series capacitors (TCSC) testing- IS 18323: Static synchronous compensator (STATCOM) testing -IS 18345: Fire prevention measures.

TOTAL :30 PERIODS

REFERENCES:

1. Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0, UGC, New Delhi.
2. A World Built on Standards: A Textbook for Higher Education, Published by: Danish Standards Foundation, 2015.
3. SO / IEC Guide 59, BIS Standards Formulation Manual, 2nd Revision, 2022.

ONLINE RESOURCES

1. https://lms.scout.org/courses/show/214209?force_course_hub=true
2. https://free-being-me.com/wp-content/media/ABC_OLDER-2.pdf
3. https://www.wagggs.org/en/what-we-do/surf-smart-20/surf-smart-get-involved/

OUTCOMES

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

1. Demonstrate improved quantitative aptitude for solving numerical problems. [K2]
2. Apply logical reasoning to tackle reasoning-based challenges. [K2]
3. Interprete verbal communication and comprehension skills through grammar and language exercises. [K2]
4. Utilize ethical principles, emotional intelligence, and leadership insights from biographies to practice responsible decision-making and professional conduct. (K3)
5. Illustrate the objectives and practices of WOSM/WAGGGS and Government of India initiatives such as Messengers of Peace, Surf Smart, and Scouts of the World Award. (K2)
6. Apply relevant Indian Standards (IS/IEC) to the selection, design, testing, and performance evaluation of power converters, UPS, switchgears, HVDC systems, and associated power electronic equipment. (K3)

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CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	2	-	-
CO2	2	2	2	2	1	-	-	-	1	-	2	-	-
CO3	2	2	2	2	-	-	-	-	1	-	2	-	-
CO4	-	-	-	-	-	2	-	3	3	3	-	-	-
CO5	-	-	-	-	-	3	2	2	2	2	1	-	-
CO6	3	2	2	-	3	1	-	-	-	-	-	-	2

SEMESTER V

COURSE CODE: 24EEID501	PROTOTYPE DEVELOPMENT LABORATORY – I	L	T	P	CP	C
		0	0	0	4	1
NPTEL CODE: -	SYLLABUS VERSION 1.1	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ESID101, 24ESID201, 24SCID301, 24SCID401					

OBJECTIVES:

- To enable students to transform innovative ideas into feasible prototype solutions through structured problem identification, design thinking, and concept development.
- To provide experiential learning in prototype design and development by focusing on user-centric requirements, iterative design, and technical validation.
- To develop proficiency in problem analysis, feasibility assessment, requirement engineering, and prototype implementation.
- To instill a foundation of innovation and entrepreneurship by integrating ethical design principles, sustainability values, and responsible technology development.
- To enable data-driven solution development through literature survey, user feedback analysis, and technology exploration.
- To facilitate multidisciplinary problem-solving through engineering design, prototype realization, testing, validation, and technical communication.

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COURSE METHODOLOGY

- This course is designed to develop innovation-oriented thinking and practical problem-solving abilities through prototype development activities focusing on real-world challenges.
- The project work shall involve the identification of a problem, requirement analysis, feasibility study, solution design, prototype development, testing, validation, and documentation. Students shall apply design thinking principles throughout the development cycle.
- Projects may be carried out individually or in groups with a maximum of three students. In the case of group projects, each student shall submit an individual project contribution report clearly specifying their role and responsibilities.
- Students shall maintain a detailed project portfolio containing problem statements, literature survey findings, design documents, prototype iterations, testing results, and validation reports.
- Periodic reviews shall be conducted to assess progress in prototype development, implementation, testing, and refinement. Students shall demonstrate prototype functionality during review evaluations.
- At the end of the semester, students shall submit a comprehensive project report and present a working prototype for evaluation by the course coordinator and project review committee.

EVALUATION

1. First Evaluation (Immediately after first internal examination): 20 Marks
   (Problem Identification and Validation, Literature Survey, Requirement Analysis, Initial Design Proposal)
2. Second Evaluation (Immediately after second internal examination): 30 Marks
   (Prototype Design Completion, Prototype Development Progress, Initial Testing and Validation Results)
3. Final Evaluation (Last week of the semester): 50 Marks
   (Functional Prototype Demonstration, Innovation and Creativity, Technical Implementation, Project Report, Viva-Voce)

Note: All three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL : 30 PERIODS

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OUTCOMES:

At the end of this course, the students should be able to:

1. Analyze real-world problems, user requirements, and design constraints to formulate innovative prototype solutions using design thinking methodologies. (K4)
2. Evaluate alternative technologies, development approaches, and feasibility aspects for prototype design and implementation. (K5)
3. Create functional prototypes by integrating appropriate tools, technologies, and engineering principles to address identified problems. (K6)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	-	-	2	3
CO2	3	3	3	---	3	-	-	-	-	-	-	2	3
CO3	3	3	3	-	3	-	-	-	-	-	-	3	3

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DOMAIN GROUP - I: GREEN ENERGY

COURSE CODE: 24ITEL501	SOLAR ENERGY SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106103224	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 13				
PRE-REQUISITE COURSES	24EEPC201, 24EEPC401					

OBJECTIVES:

- To understand the global energy scenario and describe the fundamentals of solar energy resources, radiation characteristics, and measurement techniques.
- To Interpret Sun–Earth geometry and estimate solar radiation under varying climatic conditions.
- To Analyze the working principles and performance of solar thermal collectors and thermal energy storage systems.
- To summarize the operation, characteristics, and performance parameters of solar photovoltaic cells, modules, and arrays.
- To Apply power electronic converters and control techniques for effective operation of stand-alone and grid-connected PV systems.
- To Design and evaluate solar PV and hybrid energy systems based on load requirements, resource availability, and reliability constraints.

MODULE - I FUNDAMENTALS OF SOLAR ENERGY **8**

Energy Scenario, overview of solar energy conversion devices and applications, physics of propagation of solar radiation from the sun to earth Sun-Earth Geometry, Extra-Terrestrial and Terrestrial Radiation, Solar energy measuring instruments Estimation of solar radiation under different climatic conditions, Estimation of total radiation

MODULE - II SOLAR THERMAL ENERGY STORAGE **7**

Fundamentals of solar collectors, Snails law, Bougers law, Physical significance of Transmissivity – absorptivity product. Solar Radiation-Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds- Thermal Energy storage system with PCM

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MODULE - III SOLAR PV SYSTEM 7

Fundamentals of solar PV cells, principles and performance analysis- the shockley diode equation - Structure of a solar cell - The solar cell equation - Fill factor and maximum power , I-V Characteristics modules, arrays, Types of Solar Cells, Photovoltaic Efficiency & Quality of the Cell, Interconnection of PV modules. -maximum power point tracking-Applications.

MODULE - IV MODES OF PV SYSTEM 8

Introductions to power electronics, DC-to-DC, DC-to-AC conversion (converters), and charge controllers for energy storage systems. Design of stand-alone - Typical applications for lighting, water pumping etc., and grid connected PV systems- PV System in Buildings.

MODULE - V HYBRID SYSTEMS 8

Hybrid Energy Storage system- Solar, Biomass, Wind, Diesel Hybrid systems - Comparison and selection criteria for a given application.

MODULE - VI DESIGN OF PV SYSTEM 7

Radiation and load data - Design of System Components for different PV Applications - Sizing and Reliability - Simple Case Studies.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2--2.
2. S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hil!, 2--6.
3. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice Hall India, 2nd Edition, 2-11.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 2--6
5. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, 1999.

REFERENCES:

1. H. P. Garg and J. Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill, 1997.
2. M. A. Green, Third Generation Photovoltaics: Advanced Solar Energy Conversion, Springer, 2--3.

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3. A. Goetzberger and V. U. Hoffmann, Photovoltaic Solar Energy Generation Springer- -verlag, 2-1-.
4. K. Jager, O. Isabella, A. H. M. Smets, R.A.C.M.M. Van Swaaij, and M. Zeman, Solar Energy – fundamentals, technology and systems, Delft University of Technology, 2-14
5. T. C. Kandpal and H.P. Garg, Financial Evaluation of Renewable Energy Technologies, McMillan India Ltd., 2-13

WEB RESOURCES:

1. https://web.pdx.edu/~rueterj/courses/ESM342-solar/WK3-GE-MC3-PVintro.pdf
2. https://www.advan-kt.com/principlesofsolarengi.pdf
3. https://iipseries.org/assets/docupload/rsl2-248EE3-14-CB96C2A.pdf

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc2-_ph14/preview

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply solar radiation principles to estimate available solar energy under different environmental conditions. (K3).
2. Develop the structure of Solar Thermal Energy Storage systems using the solar radiation concept.(K3)
3. Analyze the principles and performance of Solar Cell to determine its efficiency and to track the MPPT techniques in PV system (K4)
4. Classify the various types of PV System used for various applications using power electronics converters. (K4)
5. Analyze the concept of hybrid renewable energy systems and select suitable configurations for applications. (K4)
6. Examine the PV system design procedures for practical energy applications. (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	1	-	2	1
CO2	2	2	1	-	-	-	-	-	-	-	-	2	1
CO3	2	2	1	-	-	-	-	-	-	1	-	2	1
CO4	2	2	1	-	-	-	-	-	-	-	-	3	3
CO5	2	2	1	-	-	-	-	1	-	2	-	3	3
CO6	2	2	1	-	-	-	-	1	-	1	-	3	2

DOMAIN GROUP - I: GREEN ENERGY

COURSE CODE: 24EEEL502	BIOMASS ENERGY SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 103103222	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11				
PRE-REQUISITE COURSES	24EEPC201, 24BSCY201, 24EEPC401					

OBJECTIVES:

- To understand the role of biomass as a renewable energy resource
- To study the types, characteristics and availability of biomass resources
- To learn various biomass conversion technologies
- To analyze biomass-based power generation systems
- To understand environmental, economic and sustainability aspects of biomass energy
- To introduce recent trends and applications of biomass energy systems

MODULE – I INTRODUCTION TO BIOMASS ENERGY 7

Energy scenario and need for renewable energy – Biomass as an energy source – Classification of biomass: agricultural, forest, animal and municipal wastes – Biomass characteristics: moisture content, calorific value, proximate and ultimate analysis – Biomass resource assessment – Role of biomass in sustainable development.

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MODULE – II BIOMASS CONVERSION PROCESSES **8**

Overview of biomass conversion technologies – Thermochemical conversion: combustion, gasification and pyrolysis – Biochemical conversion: anaerobic digestion and fermentation – Physico-chemical conversion – Comparison of conversion processes – Selection criteria for biomass conversion systems.

MODULE – III BIOMASS COMBUSTION & GASIFICATION SYSTEMS **7**

Principle of biomass combustion – Biomass-fired boilers – Fixed bed, fluidized bed and pulverized fuel systems – Biomass gasification: downdraft and updraft gasifiers – Producer gas composition – Gas cleaning and cooling – Applications of biomass gasifiers for power generation.

MODULE – IV BIOGAS & BIOFUELS **8**

Biogas production process – Anaerobic digestion stages – Types of biogas plants: fixed dome and floating drum – Biogas plant design considerations – Biofuels: biodiesel and bioethanol – Production methods – Properties and applications – Use of biofuels in IC engines and power systems.

MODULE – V BIOMASS-BASED POWER GENERATION SYSTEMS **7**

Biomass-based power plants – Cogeneration using biomass – Combined heat and power (CHP) systems – Biomass integrated gasification combined cycle (BIGCC) – Grid integration of biomass power plants – Performance and efficiency analysis – Case studies..

MODULE – VI ENVIRONMENTAL, ECONOMIC & ADVANCED BIOMASS SYSTEMS **8**

Environmental impacts of biomass energy – Emissions and mitigation techniques – Life cycle analysis of biomass systems – Economics of biomass energy projects – Policies and incentives for biomass energy – Recent advances in biomass energy systems – Hybrid renewable energy systems with biomass – Future trends.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Khalid Syed, Bioenergy Resources and Technologies, CRC Press, First Edition, 2014.

REFERENCES

1. David Boyles, Bioenergy Technology and Applications, Wiley, First Edition, 2012.

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2. Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction, Academic Press, Second Edition, 2013.
3. Bent Sørensen, Renewable Energy Systems, Academic Press, Fourth Edition, 2011.

WEB RESOURCES:

1. https://www.iea.org
2. https://www.energy.gov
3. https://www.sciencedirect.com
4. https://www.renewableenergyworld.com

ONLINE RESOURCES:

1. https://nptel.ac.in
2. https://www.coursera.org
3. https://www.edx.org

OUTCOMES:

At the end of this course, the students should be able to:

1. Explain the fundamentals and importance of biomass energy (K3)
2. Describe various biomass conversion technologies (K3)
3. Analyze biomass combustion and gasification systems (K4)
4. Explain biogas and biofuel production processes (K3)
5. Evaluate biomass-based power generation systems (K4)
6. Assess environmental and economic aspects of biomass energy systems (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	1	2
CO2	3	2	2	1	-	-	-	-	-	-	-	2	2
CO3	3	2	2	1	-	-	-	-	-	-	-	1	2
CO4	3	2	2	1	-	-	-	-	-	-	-	1	2
CO5	2	2	2	1	-	-	-	-	1	-	-	1	2
CO6	3	2	2	1	-	-	-	-	1	-	-	1	2

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DOMAIN GROUP - I: GREEN ENERGY

COURSE CODE: 24EEEL503	SMALL HYDRO AND OCEAN ENERGY SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 103103222	SYLLABUS VERSION 1.0	SDG NO. 7, 9,13,14				
PRE-REQUISITE COURSES	24EEPC201, 24EEPC401					

OBJECTIVES:

- To understand the fundamentals and classification of small hydropower and ocean energy systems.
- To analyze hydrological parameters and site selection criteria for small hydropower plants.
- To apply selection and design principles of turbines and pumps in small hydro systems.
- To evaluate regulation, control, and performance aspects of small hydropower plants.
- To examine economic, environmental, and hybrid integration aspects of small hydro systems.
- To analyze the working principles and technologies of ocean thermal, tidal, and wave energy systems

MODULE - I SMALL HYDROPOWER SYSTEMS 7

Overview and classification of micro, mini, and small hydropower systems – Components and layout of small hydro power plants – Advantages and limitations – Role of small hydro in renewable energy development – Potential of small hydropower in India.

MODULE - II HYDROLOGY AND SITE SELECTION 7

Basics of hydrology – Rainfall–runoff relationship – Stream flow measurement techniques – Estimation of head and discharge – Site selection criteria for small hydro projects – Environmental and social considerations.

MODULE - III TURBINES, PUMPS AND REGULATION 8

Elements and working principles of hydraulic turbines and pumps – Types of turbines used in small hydropower plants – Selection and design criteria of pumps and turbines – Speed control methods – Voltage regulation techniques.

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MODULE - IV SMALL HYDRO PLANT ECONOMICS AND HYBRID SYSTEMS **8**

Plant layout and auxiliary equipment – Investment issues and cost estimation – Load management strategies – Tariff collection and regulatory aspects – Operation and maintenance – Wind–hydro based stand-alone hybrid power systems.

MODULE - V OCEAN THERMAL ENERGY CONVERSION (OTEC) **7**

Introduction to ocean energy – Ocean thermal resources – Working principle of OTEC – Open cycle, closed cycle, and hybrid OTEC systems – Site and resource requirements – Electricity generation methods – Advantages, disadvantages, and applications of OTEC.

MODULE - VI TIDAL AND WAVE ENERGY SYSTEMS **8**

Tidal Energy: Origin and nature of tidal energy – Tidal range and tidal stream technologies – Modes of operation – Merits and limitations. Wave Energy: Basics of wave motion – Power available in waves – Wave energy conversion devices – Advantages, disadvantages, and applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Warnick, C.C., 'Hydropower Engineering', Prentice-Hall Inc., Enlewood Cliffs, New Jersey, 1984.
2. Gulliver, J.S. and Arndt, E.A., "Handbook of Hydro Electric Engineering", McGraw Hills 1991.
3. Singal, S.K., Small Hydropower: Design & Analysis, Elsevier, 2023.

REFERENCES

1. Kothari, D.P., Singal, K.C. and Ranjan, R., Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, 2011.
2. Twidell, J.W. and Weir, A., Renewable Energy Resources, Taylor & Francis, London, 2015.
3. Breeze, P., Hydropower, Elsevier, Oxford, 2018.
4. Neill, S.P. and Hashemi, M.R., Fundamentals of Ocean Renewable Energy, Academic Press, London, 2018.
5. Greaves, D. and Iglesias, G., Wave and Tidal Energy, John Wiley & Sons, Chichester, 2018.

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WEB RESOURCES:

1. https://energypedia.info/wiki/Micro/Mini_Hydropower_Library_(MHL)
2. https://www.energy.gov/energysaver/microhydropower-systems

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_ge47/preview
2. https://petroedgeasia.net/training/mini-hydro-power-plant-vilt-training-course/
3. https://upskilldevelopment.com/hydropower-development-and-small-scale-water-energy-systems-training-course

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply the principles of small hydropower systems and evaluate their role in renewable energy development. (K3)
2. Analyze hydrological parameters and site selection criteria for the development of small hydropower projects. (K4)
3. Apply the working principles and selection criteria of turbines, pumps, and regulation methods used in small hydropower plants. (K3)
4. Analyze the economic aspects, operation, maintenance, and hybrid configurations of small hydropower systems. (K4)
5. Evaluate the operating principles, performance, and applications of Ocean Thermal Energy Conversion (OTEC) systems. (K5)
6. Evaluate the performance and suitability of tidal and wave energy conversion systems for sustainable power generation. (K5)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	3	2
CO2	2	3	2	-	-	-	-	-	-	-	-	2	2
CO3	2	3	2	-	-	-	-	-	-	-	-	2	2
CO4	3	2	2	-	-	-	-	-	-	-	-	2	2
CO5	2	3	2	-	-	-	-	-	-	-	-	3	3
CO6	2	3	3	-	-	-	-	-	-	-	-	3	2

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DOMAIN GROUP - I: GREEN ENERGY

COURSE CODE: 24EEEL515	NUCLEAR ENERGY SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 105106001	SYLLABUS VERSION 1.0	SDG NO. 7				
PRE-REQUISITE COURSES	24EEPC201, 24BSCY201, 24EEPC401					

OBJECTIVES:

- To elucidate on the physics involved in nuclear reaction and radiation detection
- To understand the concept of nuclear reactor theory
- To summarize the properties and classification of nuclear fuels
- To comprehend the working of nuclear power plants and economic analysis
- To understand the application of radioactivity
- To acquire knowledge on nuclear waste management, storage and regulatory issues.

MODULE - I NUCLEAR PHYSICS, RADIATION SOURCES AND DETECTION 7

Basic properties of nucleus and nuclear radiations- Nuclear Stability- Binding energy and nuclear stability- Radioactive Decay- Determination of mass of neutrino-Sources of Alpha, beta, gamma radiations, neutron sources, spontaneous fission source Detection techniques Gas filled ionization detectors Ionization chambers, proportional counters and GM counters. Pulse height spectra and energy resolution.

MODULE - II NUCLEAR REACTOR THEORY 7

Fissile and fertile atoms, conversion of fertile into fissile atoms, Fission power, fission chain, control of fission chain, Effective multiplication factor, concept of criticality, sub criticality and super criticality. Conversion / breeding ratio, fuel burn-up. Selection of reactor materials fuel and cladding, corrosion, pressure vessel materials.

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MODULE - III NUCLEAR REACTOR MATERIALS AND FUELS 7

Nuclear fuels Properties of Uranium metal, UO2 and UC. Fuel elements-Thermal properties, Stress analysis of fuel elements, Fuel Chemistry, Solid fission products, corrosion in nuclear reactors, primary failure modes of fuel elements. Radio Isotopes

MODULE - IV NUCLEAR POWER ENGINEERING AND ECONOMICS 8

Principles of conversion Types of nuclear power plants Fast breeder reactors-Breeding requirements and fast reactors, Fast reactor system features Economics of nuclear power plants- capital costs, fuel costs and O&M (operations and maintenance) costs, Economics of nuclear vs. other types of power plants.

MODULE - V APPLICATION OF RADIATION TECHNOLOGY 8

Applications using gamma ray attenuation & scattering, Borehole logging, Radio gauging principles.Beta transmission gauges for measurements of sheets thickness, density and composition analysis. X-ray fluorescence principles. Material analysis Basic principles, nuclear techniques for elemental analysis, Rutherford back scattering (RBS) and elastic recoil detection analysis (ERDA).Medical applications Projection imaging, positron emission tomography, magnetic resonance imaging, radiation therapy. Sterilization plants

MODULE - VI NUCLEAR WASTE STORAGE AND MANAGEMENT 8

Classification of nuclear waste, environmental impacts of nuclear waste, nuclear decay law, nuclear fuel cycle. Treatment of liquid and solid radioactive wastes, hydraulic cements in waste immobilization and cementation technology. Storage and disposal Deep geologic disposal Design principles and evaluation methods Repository requirements and site selection multi-barrier concept Regulatory environment and community Issues, International scenarios for permanent disposal.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kenneth S. Krane, Introductory Nuclear Physics. Hoboken: John Wiley & Sons, Inc. (1987).
2. G.F.Knoll, Radiation Detection and Measurement, 3rd Edition, John Wiley and Sons (2000)

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3. S.Garg, F. Ahmed and L.S.Kothari, Physics of Nuclear Reactors, Tata McGraw Hill, New Delhi (1986).

REFERENCES:

1. S. E. Liverhant Elementary Introduction to Nuclear Reactor Theory ,Publisher: John Wiley and sons, INC, second print (1966)
2. Was and Gary S,Fundamentals of Radiation Materials Science Metals and Alloys,Springer,2017.
3. John Lilley, Nuclear Physics, Principles and Application, John Wiley (2002).
4. James H. Saling, Audeen W. Fentiman, Yu S. Tang, Radioactive Waste Management, Taylor & Francis, 2001.

WEB RESOURCES:

1. https://faculty.kfupm.edu.sa/phys/aanaqvi/NaqEmploy_files/Syed%20Naeem%20Ahmed%20Physics%20and%20Engineering%20of%20Radiation%20Detection%20%202007.pdf
2. https://indico.ictp.it/event/10781/session/6/contribution/54/material/slides/0.pdf
3. https://wjarr.com/sites/default/files/WJARR-2019-0114.pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112101007

OUTCOMES:

At the end of this course, the students should be able to:

1. Identify the basic properties of nucleus, nuclear radiations, radioactive decay processes, radiation sources, and the operating principles of radiation detectors. (K3)
2. Analyze the principles of nuclear fission, chain reactions, reactor criticality, breeding ratio, and the selection of reactor materials and fuels. (K4)
3. Examine the properties of nuclear fuels, fuel element behavior, corrosion mechanisms in nuclear reactors. (K4)
4. Analyze the operation, system features, and economic aspects of nuclear power plants and fast breeder reactors.. (K4)
5. Utilize radiation technologies for industrial measurements, material analysis, medical imaging, radiation therapy, and sterilization applications (K4)

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6. Examine radioactive waste treatment, storage, disposal methods, repository design principles, and environmental impacts of nuclear waste management.(K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	-	-	2	-	-	-	-	-	2	2	-
CO3	3	2	-	-	2	-	-	-	-	-	2	2	-
CO4	3	2	-	-	3	-	-	-	-	-	2	2	-
CO5	3	3	-	-	2	-	-	-	-	-	2	2	-
CO6	3	3	-	-	3	-	-	-	-	-	2	2	-

DOMAIN GROUP - I: GREEN ENERGY

COURSE CODE: 24EEEL516	FUNDAMENTALS OF ENERGY AND ENVIRONMENT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 7, 13				
PRE-REQUISITE COURSES	24BSCY201					

OBJECTIVES:

- Introduce fundamental concepts of energy resources and energy conversion.
- Create awareness about renewable and non-renewable energy systems.
- Explain the environmental impacts of energy production and utilization.
- Provide knowledge on pollution sources, effects, and control methods.
- Develop understanding of sustainability, climate change, and energy management.
- Familiarize students with future energy technologies and environmental assessment tools.

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MODULE - I ENERGY BASICS AND RESOURCES 7

Definition and classification of energy-Conventional energy sources: coal, petroleum, natural gas-Non-conventional energy sources: solar, wind, biomass, hydro, geothermal-Energy units, energy conversion, efficiency-Global and Indian energy scenario

MODULE - II ENERGY CONVERSION AND UTILIZATION 7

Principles of energy conversion-Thermal power plants – working and environmental impacts-Nuclear power – basics, advantages and risks-Cogeneration and combined cycle power plants-Energy utilization in domestic, industrial, and transportation sectors

MODULE - III RENEWABLE ENERGY TECHNOLOGIES 8

Solar energy: solar thermal and solar PV systems-Wind energy: wind turbines and site selection-Biomass energy: biogas plants, biofuels-Small hydro and tidal energy-Advantages and limitations of renewable energy systems

MODULE - IV ENVIRONMENTAL POLLUTION AND CONTROL 7

Air pollution: sources, effects, and control measures-Water pollution: sources, effects, and treatment methods-Soil and noise pollution-Solid waste management and e-waste-Environmental standards and regulations

MODULE - V ENERGY, ENVIRONMENT, AND SUSTAINABILITY 8

Energy–environment interactions-Climate change and global warming-Greenhouse gases and carbon footprint-Sustainable development concepts-Energy conservation and energy management

MODULE - VI ENVIRONMENTAL IMPACT AND FUTURE ENERGY SYSTEMS 8

Environmental Impact Assessment (EIA)-Life Cycle Assessment (LCA)-Smart grids and energy storage systems-Electric vehicles and hydrogen energy-Future trends in energy and environmental protection

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rai, G.D., Non-Conventional Energy Sources, Khanna Publishers, New Delhi.5th edition-2011
2. Twidell, J. and Weir, T., Renewable Energy Resources, 3rd Edition, Routledge, UK.2015

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3. Boyle, G., Renewable Energy: Power for a Sustainable Future, Oxford University Press, Fourth edition 2017

REFERENCE BOOKS

1. Kreith, F. and Goswami, D.Y., Handbook of Energy Efficiency and Renewable Energy, CRC Press.2007
2. Masters, G.M., Renewable and Efficient Electric Power Systems, Wiley.2013

ONLINE SOURCES

1. Energy Resources, Economics and Sustainability https://onlinecourses.nptel.ac.in/noc24_hs77/preview?utm_source=chatgpt.com
2. Renewable Energy Technologies-https://onlinecourses.swayam2.ac.in/ntr25_ed119/preview
3. Environment and Development-https://onlinecourses.nptel.ac.in/noc25_hs195/preview
4. Sustainable Energy Technology-https://onlinecourses.nptel.ac.in/noc25_me178/preview

WEB SOURCES

1. Ministry of New and Renewable Energy (MNRE), Govt. of India – Policies and reports- https://mnre.gov.in/
2. Central Pollution Control Board (CPCB), India – Environmental standards and reports- https://cpcb.nic.in/

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply fundamental concepts of energy, energy resources, and energy scenarios to interpret real-world energy supply and demand scenarios. [K3]
2. Analyze the principles of energy conversion systems in thermal, nuclear, and cogeneration power plants to evaluate their operational performance. [K4]
3. Analyse different renewable energy technologies and their applications in various energy sectors. [K4]
4. Identify various types of environmental pollution and recommend suitable control measures [K3]

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5. Analyse principles of sustainable development, energy conservation, and climate change mitigation strategies for sustainable energy management. [K4]
6. Evaluate the environmental impacts of energy projects and assess future energy systems [K4]

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	1	2	1
CO2	3	3	2	1	-	-	-	-	-	-	1	2	1
CO3	3	3	2	1	-	-	-	-	-	-	1	2	1
CO4	3	2	2	1	-	-	-	-	-	-	1	2	1
CO5	3	3	2	1	-	-	-	-	-	-	1	2	1
CO6	3	3	2	1	-	-	-	-	-	-	1	2	1

DOMAIN GROUP - I: GREEN ENERGY

COURSE CODE: 24EEEL517	WIND ENERGY CONVERSION SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11				
PRE-REQUISITE COURSES	24EEPC402					

OBJECTIVES:

- To introduce the global and Indian wind energy scenario and assess the role of wind energy in sustainable power generation.
- To understand wind characteristics, atmospheric circulation, and methods of wind data collection and analysis.
- To impart knowledge on aerodynamic principles governing wind turbines, including lift, drag, and power extraction limits.
- To study various types of wind turbines, their constructional features, and major mechanical components.

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- To analyze electrical generators, drive train configurations, and power electronic interfaces used in wind energy systems.
- To evaluate wind turbine control strategies, grid integration issues, and economic aspects of wind energy applications.

MODULE - I WIND ENERGY INTRODUCTION AND RESOURCES 8

Energy scenario and role of wind energy – Global and Indian wind energy status – Advantages and limitations of wind energy – Atmospheric circulation – Origin of wind – Wind characteristics – Wind speed variation with height – Weibull distribution – Wind data collection and analysis.

MODULE - II AERODYNAMICS OF WIND TURBINES 7

Basic aerodynamics – Lift and drag forces – Power in the wind – Betz limit – Tip speed ratio – Power coefficient – Blade element theory – Performance characteristics of wind turbines – Effect of solidity and pitch angle.

MODULE - III WIND TURBINE TYPES AND COMPONENTS 7

Classification of wind turbines – Horizontal axis wind turbines (HAWT) – Vertical axis wind turbines (VAWT) – Fixed speed and variable speed turbines – Main components: rotor, blades, hub, nacelle, gearbox, generator, tower – Braking and yaw mechanisms.

MODULE - IV ELECTRICAL GENERATORS AND DRIVE TRAINS 7

Generator types for wind energy systems – Squirrel cage induction generator – Doubly fed induction generator (DFIG) – Permanent magnet synchronous generator (PMSG) – Direct drive systems – Power electronics interface – AC–DC–AC converters – Grid synchronization.

MODULE - V CONTROL AND GRID INTEGRATION OF WECS 7

Wind turbine control strategies – Pitch control – Stall control – Yaw control – Maximum power point tracking (MPPT) – Reactive power control – Power quality issues – Grid codes – Fault ride-through capability – Hybrid wind energy systems.

MODULE - VI APPLICATIONS AND ECONOMICS OF WIND ENERGY 9

Wind farm layout and design – Site selection – Offshore and onshore wind farms – Environmental impacts – Noise and shadow flicker – Economic analysis – Cost of energy – Wind energy in standalone and grid-connected applications – Future trends in wind energy.

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. Sathyajith Mathew, Wind Energy – Fundamentals, Resource Analysis and Economics, Springer, 2006.
2. Erich Hau, Wind Turbines: Fundamentals, Technologies, Application, Economics, Springer, 2013.
3. L.L. Freris and D.G. Infield, Renewable Energy in Power Systems, Wiley, 2008.

REFERENCES:

1. Tony Burton et al., Wind Energy Handbook, John Wiley & Sons, 2011.
2. R. Gasch and J. Twele, Wind Power Plants, Springer, 2012.
3. Ackermann Thomas, Wind Power in Power Systems, Wiley, 2005.

WEB RESOURCES:

1. https://www.ieawind.org
2. https://www.nrel.gov/wind/
3. https://www.globalwindatlas.info
4. https://www.renewableenergyworld.com
5. https://mnre.gov.in

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply knowledge of wind energy resources to assess wind potential and site suitability for sustainable power generation.(K3)
2. Analyze wind characteristics and aerodynamic principles of wind turbines. (K4)
3. Analyze the functions and performance of major turbine components (blades, gearbox, generator, tower). (K4)
4. Evaluate generators and power electronic interfaces used in WECS. (K5)
5. Analyze control strategies and grid integration issues of wind energy systems. (K4)
6. Evaluate the technical parameters of wind energy system and its economic aspects(K5).

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	2	1	3	-	-	-	-	1	2
CO2	3	3	2	2	2	-	2	-	-	-	-	2	2
CO3	3	2	2	1	1	1	2	-	-	-	-	2	1
CO4	3	3	2	2	3	1	1	-	-	-	-	3	3
CO5	3	3	3	2	3	2	2	1	-	-	1	3	3
CO6	3	2	3	1	1	3	3	1	1	1	3	1	2

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DOMAIN GROUP - I: POWER ELECTRONICS

COURSE CODE: 24EEEL504	POWER ELECTRONICS APPLICATIONS IN POWER SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117103488	SYLLABUS VERSION 1.0	SDG NO. 4, 7				
PRE-REQUISITE COURSES	24EEPC201, 24EEPC303, 24EEPC304					

OBJECTIVES:

- To understand the operation and control of power electronic converters in power systems.
- To analyze converter control modes, harmonics, filtering techniques, and ripple reduction methods.
- To study HVDC transmission system control and coordinated operation.
- To acquire comprehensive knowledge of shunt, series, and combined FACTS controllers.
- To analyze the role of FACTS devices in improving voltage control, power flow, and system stability.
- To examine recent developments in HVDC technologies and renewable integration.

MODULE - I CONVERTER OPERATION IN POWER SYSTEMS 7

Rectifier and inverter operation in power systems – Two-valve operation – Two/three-valve operation – Three/four-valve operation – Voltage and current equations of converters – Converter characteristics – Control charts – Basic converter control concepts.

MODULE - II CONTROL OF HVDC CONVERTERS AND SYSTEMS 6

Converter control strategies – Control of rectifier and inverter in HVDC systems – Constant current control – Constant extinction angle control – Power reversal – DC voltage control – Coordinated control of HVDC systems – Dynamic performance of HVDC links.

MODULE - III HARMONICS, FILTERING AND PROTECTION IN HVDC SYSTEMS 8

Characteristics and non-characteristic harmonics – Harmonic generation in converters – AC and DC harmonic filters – Design considerations of harmonic

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filters – Smoothing reactor – Earthing arrangements in HVDC systems – Protection of HVDC converters and DC lines.

MODULE - IV SHUNT AND SERIES COMPENSATION USING FACTS 9

Objectives of shunt compensation – Objectives of series compensation – Reactive power control – Operation of shunt compensators (SVC, STATCOM) – Operation of series compensators (TCSC, SSSC) – Impact on voltage control, power flow and system stability.

MODULE - V ADVANCED FACTS CONTROLLERS AND STABILITY ENHANCEMENT 7

Operation of thyristor-controlled voltage regulator – Thyristor-controlled phase angle regulator – Unified Power Flow Controller (UPFC) – Interline Power Flow Controller (IPFC) – Subsynchronous resonance (SSR) – NGH-SSR damping methods – Thyristor controlled braking resistor (TCBR).

MODULE - VI RECENT DEVELOPMENTS IN HVDC TECHNOLOGY 8

Introduction to current HVDC technologies – VSC-HVDC systems – Modular Multilevel Converters (MMC) – Multi-terminal HVDC – HVDC grids – Application of HVDC in renewable energy integration – Future trends in HVDC transmission.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Understanding of FACTS: Hingorani N. G., IEEE Press, (1996).
2. FACTS controller in Power Transmission & Distribution:1st Ed.: Padiyar K.R., New Age Int. (P) Ltd, (2007).
3. HVDC and FACTS Controllers: Applications of Static Converters in Power Systems, Vijay K. Sood ,Springer-Verlag New York Inc.; (2004).
4. Sood, V.K., HVDC and FACTS Controllers: Applications of Static Converters in Power Systems, Springer, 2004.
5. Direct Current Transmission, Vol.I: E. W. Kimbark, Wiley Interscience,(1971).
6. HVDC Power Transmission Systems: K. R. Padiyar, Wiley Eastern Ltd., (1990).

REFERENCES

1. Static Reactive Power Compensation: Miller T.J.E., John Wiley & Sons, New York, (1982).

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2. Flexible AC Transmission System. (FACTs): Yong Hua Song, IEE (1999).
3. Power Transmission by Direct Current: Erich Uhlmann., B.S. Publications,(2004).
4. High Voltage Direct Transmission: J. Arrillaga, Peter Peregrinus Ltd. London, (1983).

WEB RESOURCES:

1. Top Power Electronics Courses Online - Updated [December 2025]
2. Power Electronics - GeeksforGeeks

ONLINE RESOURCES:

1. nptel.ac.in/courses/117103488
2. 9AKK107680A2878-B-en-Power system dynamics| Hitachi Energy

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply the fundamentals of HVAC and HVDC transmission systems and their applications in modern power systems.(K3)
2. Analyze the operation and control of power electronic converters used in HVDC systems, including control modes, harmonics, and filtering techniques.(K4)
3. Identify power quality issues in power systems and evaluate harmonic mitigation, ripple reduction, and protection methods.(K3)
4. Explain the operating principles and performance of shunt, series, and combined FACTS controllers.(K3)
5. Analyze the role of advanced FACTS controllers in power flow control, voltage regulation, and system stability enhancement.(K4)
6. Apply knowledge of FACTS and HVDC technologies to assess and implement suitable controllers for modern power system applications.(K3)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	3	-	-	-	-	-	-	3	2
CO2	3	3	3	2	3	-	-	-	-	-	-	3	2
CO3	3	3	3	2	3	-	3	-	-	-	-	3	2
CO4	3	3	3	2	3	-	-	-	-	-	-	3	-
CO5	3	3	3	2	3	-	3	-	-	-	-	3	2
CO6	3	3	3	2	3	-	3	-	3	3	3	3	2

DOMAIN GROUP - I: POWER ELECTRONICS

COURSE CODE: 24EEEL505	SMPS AND UPS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 7, 9				
PRE-REQUISITE COURSES	24EEPC201, 24ESEE401					

OBJECTIVES:

- To apply the operating principles of non-isolated and isolated DC–DC converters for practical power conversion applications.
- To analyze and design SMPS components such as converters, magnetic elements, filters, and control circuits.
- To implement feedback and control techniques (P, PI, PID) for voltage regulation and performance improvement in SMPS.
- To apply design concepts of UPS systems for reliable power supply in IT, medical, and industrial applications.
- To use power electronic converters effectively in renewable energy systems, hybrid electric vehicles, and modern power grids.
- To apply power conditioning and filtering techniques to mitigate power quality issues and improve system reliability.

MODULE - I NON-ISOLATED DC-DC CONVERTER 7

Basic topologies: Buck, Boost, Buck-Boost converters-Operation principles (Continuous Conduction Mode)-Design and analysis steady-state relationships-Introduction to Discontinuous Conduction Mode.

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MODULE - II ISOLATED DC-DC CONVERTERS **7**

Classification of isolated converters-Flyback Converter, Forward Converter, Push-Pull Converter-Half-Bridge and Full-Bridge Converters-Introduction to design of magnetic components for SMPS.

MODULE - III SMPS DESIGN AND COMPONENTS **7**

High-frequency transformers and inductors-Output rectifiers and filters-Feedback and regulation techniques-Control ICs used in SMPS-Design and simulation of P, PI & PID controllers-Thermal management and efficiency improvement.

MODULE - IV UNINTERRUPTIBLE POWER SUPPLY (UPS) **8**

Need and classification of UPS systems-Offline (Standby) UPS-Line-Interactive UPS-Block diagrams and operation-Comparison of different UPS systems-Applications of UPS in IT, medical, and industrial systems.

MODULE - V APPLICATIONS OF POWER CONVERTERS **8**

Applications in Hybrid Electric Vehicles (HEVs)-Applications in Renewable Energy Systems (Solar, Wind)-Integration of power electronics in modern electrical grids-Energy management in Hybrid Electric Vehicles (HEVs).

MODULE - VI POWER CONDITIONING, UPS & TESTING **8**

Power disturbances and their mitigation using power conditioners-Battery charging methods and battery management-Harmonics and power quality issues in UPS-Maintenance, testing, and reliability of UPS.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rashid, M.H., "Power Electronics: Circuits, Devices and Applications", 5th Edition, Pearson Education, 2024.
2. Erickson, R.W. and Maksimovic, D., "Fundamentals of Power Electronics", 3rd Edition, Springer International Publishing, 2020.
3. Bimbhra, P.S., "Power Electronics", 6th Edition, Khanna Publishers, New Delhi, 2021.

REFERENCE BOOKS

1. Mohan, N., Undeland, T.M. and Robbins, W.P., "Power Electronics: Converters, Applications and Design", 4th Edition, Wiley India, 2023.

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2. Hart, D.W., "Power Electronics", 2nd Edition, McGraw Hill Education, 2021.
3. Pressman, A.I., Billings, K. and Morey, T., "Switching Power Supply Design", 3rd Edition, McGraw Hill Professional, 2018.
4. Abraham I. Pressman, Keith Billings and Taylor Morey, "Switching Power Supply Design", 3rd Edition, McGraw Hill, 2018.
5. Bose, B.K., "Modern Power Electronics and AC Drives", 1st Edition, Pearson Education, 2020.
6. Ali Emadi, "Advanced Electric Drive Vehicles", 1st Edition, CRC Press, 2017.
7. Kharbanda, O.P., "Power Quality and UPS Systems", 2nd Edition, Laxmi Publications, 2019.

WEB RESOURCES

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ee97
2. https://nptel.ac.in/courses/108108036
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ee99
4. https://www.ti.com/product-category/power-management/overview.html
5. https://www.analog.com/en/products/power-management.html
6. https://www.ieee-pels.org/

ONLINE RESOURCES

1. https://www.mathworks.com/videos/series/how-to-develop-dc-dc-converter-control-in-simulink.html
2. https://www.analog.com/en/resources/media-center/videos/series/ltspice-essentials-tutorial.html
3. https://webench.ti.com/power-designer/switching-regulator

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply steady-state analysis and design equations of buck, boost, and buck-boost converters operating in CCM and DCM for given specifications. (K3)
2. Apply appropriate isolated DC–DC converter topologies (flyback, forward, push-pull, half-bridge, full-bridge) and design basic magnetic components for SMPS applications. (K3).

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3. Design and simulate SMPS subsystems, including high-frequency transformers, rectifiers, filters, and feedback controllers (P, PI, PID), considering efficiency and thermal constraints. (K3)
4. Apply the principles of different UPS configurations (offline, line-interactive) to select and implement suitable UPS systems for specific applications. (K3)
5. Apply power converter concepts in hybrid electric vehicles, renewable energy systems, and grid-connected applications for effective energy management. (K3)
6. Apply power conditioning, battery management, and filtering techniques to mitigate power disturbances, harmonics, and reliability issues in UPS systems. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	1	3	1
CO2	3	2	3	-	-	-	-	-	-	-	1	3	1
CO3	3	2	3	-	2	-	-	-	-	-	2	3	2
CO4	3	2	2	-	-	1	-	-	-	-	2	2	2
CO5	3	2	2	-	-	1	2	-	-	-	2	3	2
CO6	3	2	2	-	-	1	2	-	-	-	2	2	2

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DOMAIN GROUP - I: POWER ELECTRONICS

COURSE CODE: 24EEEL506	DESIGN AND ANALYSIS OF DC-DC CONVERTER	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 7				
PRE-REQUISITE COURSES	24EEPC201					

OBJECTIVES:

- To understand the operating principles and characteristics of various DC–DC converters.
- To analyse the steady-state and dynamic behavior of DC–DC converters in continuous and discontinuous conduction modes.
- To model and design DC–DC converters for practical power electronic applications.
- To introduce state-space modelling and small-signal analysis of converters.
- To examine the stability of DC-DC converters.
- To develop skills in simulation and performance evaluation of DC–DC converters using MATLAB/Simulink.

MODULE - I DC–DC BUCK CONVERTER **8**

Principle of operation—Switching modes—Continuous and discontinuous conduction modes—Steady-state analysis—Output voltage, ripple voltage, and ripple current—Design of inductor and capacitor—State-space modelling—Applications—MATLAB/Simulink-based simulation.

MODULE - II DC–DC BOOST CONVERTER **8**

Operating principle – Modes of operation – Steady-state analysis – Voltage conversion ratio – Ripple analysis – Design considerations – Continuous conduction condition – State-space modelling – Applications – MATLAB/Simulink simulation.

MODULE - III DC–DC BUCK–BOOST AND CUK CONVERTERS **8**

Buck–Boost converter: principle, modes, steady-state analysis, design, CCM condition, applications, simulation. Cuk converter: principle, modes of operation, voltage inversion, ripple characteristics, design of energy storage elements, state-space modelling, applications, and simulation.

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MODULE - IV NON-ISOLATED AND INTERLEAVED DC–DC CONVERTERS **7**

SEPIC converter – Zeta converter – Luo converter – Interleaved DC–DC converters – Principle of operation – Advantages and limitations – Design issues – Applications in renewable energy systems and electric vehicles.

MODULE - V MODELLING AND BODE PLOT ANALYSIS **7**

Transfer function of electrical circuits—State-space averaging—Small-signal modelling of DC–DC converters—Control-to-output transfer function—Bode plot fundamentals—Gain margin and phase margin—Stability analysis—MATLAB-based demonstration.

MODULE - VI DESIGN APPLICATIONS AND CASE STUDIES **7**

Design and modelling of Buck, Boost, Buck–Boost and Cuk converters for practical applications – Continuous conduction verification – Controllability and observability – Comparative performance analysis – Introduction to MPPT-based DC–DC converter applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Erickson, R. W., and Maksimovic, D., Fundamentals of Power Electronics, 2nd Edition, Springer, 2001.
2. Rashid, M. H., Power Electronics: Circuits, Devices and Applications, 4th Edition, Pearson Education, 2014.

REFERENCES

1. Mohan, N., Undeland, T. M., and Robbins, W. P., Power Electronics: Converters, Applications and Design, Wiley, 2003.
2. Bimal N. Bose, Power Electronics and Motor Drives, Academic Press, 2006.
3. Middlebrook, R. D., and Cuk, S., "A General Unified Approach to Modelling Switching-Converter Power Stages," IEEE PESC Proceedings.

WEB REFERENCES

1. https://www.eepower.com
2. https://www.allaboutcircuits.com
3. https://www.mathworks.com
4. https://ieeexplore.ieee.org

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OUTCOMES:

At the end of this course, the students should be able to:

1. Examine the operating principles of basic and advanced DC–DC converters. (K4)
2. Discriminate the continuous and discontinuous modes of DC–DC converters. (K4)
3. Explore DC–DC converters for specified electrical requirements. (K4)
4. Analyze state-space and small-signal models of converters. (K4)
5. Examine stability of the DC–DC converters using Bode plot techniques. (K4)
6. Categorize the performance of the DC–DC converter through performance using MATLAB/Simulink (K4).

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	2	-	-	-	-	-	2	3	3
CO2	3	3	3	-	2	-	-	-	-	-	2	3	3
CO3	2	3	3	2	2	-	-	-	-	-	2	3	3
CO4	2	3	3	2	-	-	-	-	-	-	2	3	2
CO5	2	3	3	2	2	-	-	-	-	-	2	3	3
CO6	2	2	3	3	2	-	-	-	-	2	3	3	3

DOMAIN GROUP - I: POWER ELECTRONICS

COURSE CODE: 24EEEL518	LINE COMMUTATED AND PWM RECTIFIERS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108102717	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 12				
PRE-REQUISITE COURSES	24EEPC201, 24EEPC303					

OBJECTIVES:

- To analyze single-phase and three-phase diode rectifiers with passive filters under continuous and discontinuous conduction, including commutation effects.

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- To analyze the operation and conduction characteristics of single-phase and three-phase thyristor rectifiers with passive filtering.
- To examine 6-pulse and 12-pulse converter configurations and assess commutation overlap, harmonic reduction, and notch effects.
- To analyze the steady-state operation and closed-loop control of single-switch AC–DC boost converters for unity power factor.
- To evaluate the operating modes and steady-state performance of bidirectional AC–DC boost converters under different power factor conditions.
- To apply flyback converter principles to analyze voltage conversion and unity power factor operation in isolated AC–DC converters.

MODULE - I DIODE RECTIFIERS WITH PASSIVE FILTERING 7

Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap.

MODULE - II THYRISTOR RECTIFIERS WITH PASSIVE FILTERING 7

Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.

MODULE - III MULTI-PULSE CONVERTER 7

Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac,6- pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

MODULE - IV SINGLE-PHASE AC-DC SINGLE-SWITCH BOOST CONVERTER 8

Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

MODULE - V AC-DC BIDIRECTIONAL BOOST CONVERTER 8

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

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MODULE - VI ISOLATED SINGLE-PHASE AC-DC FLYBACK CONVERTER 8

Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison Wesley, 1991.
3. L. Umanand, " Power Electronics: Essentials and Applications", Wiley India,2009.
4. N. Mohan and T. M. Undeland, " Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
5. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001.

REFERENCE BOOKS:

1. Power Electronic Circuit by Issa Batraseh, Wiley Publication
2. Modern Power Electronics and AC Drives, by B.K. Bose, Prentice Hall India Learning Private Limited

WEB RESOURCES:

1. Coursera – Power Electronics (University of Colorado Boulder / University of Illinois), https://www.coursera.org
2. edX – Power Electronics (Delft University of Technology – TU Delft),https://www.edx.org
3. MIT OpenCourseWare – Power Electronics, https://ocw.mit.edu

ONLINE RESOURCES:

1. NPTEL (National Programme on Technology Enhanced Learning) – Line Commutated and PWM Rectifiers (Prof. Anandarup Das, IIT Delhi) https://nptel.ac.in/courses/108102717

OUTCOMES:

At the end of this course, the students should be able to:

1. Utilize the principles of single-phase and three-phase diode rectifiers with passive filters to solve performance-related problems under various load conditions. (K3)

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2. Implement thyristor-controlled rectifier concepts to solve problems related to conduction modes and input current waveforms. (K3)
3. Analyze multi-pulse converter configurations by examining transformer phase shifting, commutation overlap, and notch formation. (K4)
4. Develop steady-state models and construct control strategies for single-switch AC–DC boost converters to achieve unity power factor operation. (K3)
5. Examine and categorize the operating modes of bidirectional AC–DC boost converters under leading, lagging, and unity power factor conditions using phasor diagrams. (K4)
6. Utilize flyback converter principles to develop voltage conversion models and solve problems related to unity power factor operation. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	1	-	-	-	-	-	-	-	2	1
CO2	3	2	-	1	-	-	-	-	-	-	-	2	1
CO3	2	3	-	2	-	-	-	-	-	-	-	2	1
CO4	2	3	2	2	-	-	-	-	-	-	-	3	2
CO5	2	3	1	2	-	-	-	-	-	-	-	3	2
CO6	2	2	2	2	-	-	-	-	-	-	-	3	2

DOMAIN GROUP - I: POWER ELECTRONICS

COURSE CODE: 24EEEL519	ANALYSIS OF INVERTERS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 7				
PRE-REQUISITE COURSES	24EEPC201, 24BSPH201					

OBJECTIVES:

- To provide an understanding of electrical circuit concepts and operating principles of various inverter topologies.

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- To equip students with skills to derive design criteria for inverters used in UPS and motor drive applications.
- To analyze the operating modes and performance characteristics of single-phase and three-phase inverters.
- To design and implement different inverter configurations with suitable control strategies.
- To impart knowledge of multilevel inverters and advanced PWM/modulation techniques.
- To introduce Z-source and impedance-source inverter concepts for improved voltage gain and reliability.

MODULE - I FUNDAMENTALS OF SINGLE-PHASE INVERTERS 7

Principle of operation of half-bridge and full-bridge inverters- Square wave inverters—Performance parameters: THD, RMS, form factor, distortion factor—Voltage control methods—Harmonic analysis and elimination techniques—Forced commutated thyristor inverters.

MODULE - II PWM TECHNIQUES FOR SINGLE-PHASE INVERTERS 7

Sinusoidal PWM (SPWM)—Multiple PWM—Selective Harmonic Elimination (SHE)—Unipolar and Bipolar Switching—Digital PWM Implementation—Applications in UPS Systems.

MODULE - III THREE-PHASE VOLTAGE SOURCE INVERTERS 8

180° and 120° conduction modes—star and Delta connected loads— Line and phase voltage analysis- Voltage control of three-phase inverters—Sinusoidal PWM, Multi-pulse modulation-Space Vector Modulation (SVM) -Applications to AC drive systems- Case studies on variable frequency drives.

MODULE - IV CURRENT SOURCE INVERTERS 8

Six-step thyristor current source inverter—Inverter operating modes—Load-commutated inverters- Auto Sequential Current Source Inverter (ASCI) - Current pulsations and filtering - Comparison between VSI and CSI-PWM techniques for CSI.

MODULE - V MULTILEVEL AND Z-SOURCE/BOOST INVERTERS 8

Multilevel inverter concept—Diode-clamped (NPC) MLI-Flying capacitor MLI-Cascaded H-Bridge MLI: Comparison and applications of MLI-PWM techniques for MLI-Z-Source Inverters—impedance network, shoot-through

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states, boost capability—single-phase and three-phase impedance source inverters.

MODULE - VI RESONANT INVERTERS AND POWER CONDITIONER 7

Series resonant inverter, Parallel resonant inverter—voltage control of resonant inverters—class-E resonant inverter—resonant DC-link inverter—power line disturbances—power conditioners—offline UPS and online UPS.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rashid M.H., Power Electronics: Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, 2004.
2. Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson Education India, 2nd Edition, 2003.
3. Ned Mohan, T.M. Undeland & W.P. Robbins, Power Electronics: Converters, Applications and Design, Wiley India Edition, 2006.
4. P.S. Bimbra, Power Electronics, Khanna Publishers, New Delhi, Latest Edition.

REFERENCES

1. Jai P. Agrawal, Power Electronics Systems, Pearson Education India, 2nd Edition, 2002.
2. P.C. Sen, Modern Power Electronics, Wheeler Publishing / S. Chand India, 1st Edition.
3. M.D. Singh & K.B. Khanchandani, Power Electronics, McGraw-Hill Education India, Latest Edition. (Strong coverage of Multilevel Inverters and Control Techniques)
4. V.R. Moorthi, Power Electronics – Devices, Circuits, and Industrial Applications, Oxford University Press India.
5. N.K. De & Prashant K. Sen, Electric Drives, PHI Learning India.

WEB REFERENCE

1. https://nptel.ac.in/courses/108/105/108105066/.
2. https://testbook.com/electrical-engineering/inverter-circuit
3. https://en.wikipedia.org/wiki/Power_electronics.
4. https://en.wikipedia.org/wiki/Z-source_inverter.
5. https://www.theengineeringprojects.com/2014/12/introduction-multilevel-inverters.html.

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OUTCOMES:

At the end of this course, the students should be able to:

1. Analyse the performance of single-phase inverters. (K4)
2. Apply PWM and harmonic reduction techniques for inverter voltage control. (K3)
3. Explore the control strategies for three-phase voltage source inverters used in drives. (K4)
4. Distinguish and analyse operating modes of current source inverters. (K4)
5. Compare the multilevel inverter topologies for industrial applications. (K3)
6. Analyse and design resonant and Z-source inverters for power conditioning and UPS systems. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	2	3	2
CO2	3	3	3	-	-	-	-	-	-	-	2	3	2
CO3	3	3	3	1	-	1	-	-	-	-	2	3	3
CO4	3	2	2	-	-	-	-	-	-	-	2	3	2
CO5	3	3	3	-	-	-	-	-	-	-	2	3	3
CO6	3	3	3	-	-	-	-	-	-	-	2	3	2

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DOMAIN GROUP - I: POWER ELECTRONICS

COURSE CODE: 24EEEP503	POWER ELECTRONICS FOR SUSTAINABLE ENERGY TECHNOLOGIES LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 13				
PRE-REQUISITE COURSES	24EEPL301					

OBJECTIVES:

- To provide a comprehensive understanding of the working principles, modeling, and control of non-isolated DC-DC converters.
- To familiarize students with various isolated DC-DC converter topologies and the design requirements of their gate drive circuits.
- To introduce the principles of resonant converter operation, the design of snubber circuits, and the fundamentals of magnetic component design.
- To explain the operation of different inverter configurations, advanced modulation techniques, and multilevel inverter systems.
- To explore the dynamic switching behavior, trajectories, and loss characteristics of modern semiconductor power devices.
- To demonstrate the practical integration and application of these power electronic systems in sustainable energy technologies such as Solar PV, Wind energy, and Electric Vehicle (EV) infrastructure

MODULE - I FUNDAMENTALS OF NON-ISOLATED DC-DC CONVETERS8

Operation and waveform analysis of Buck, Boost, and Buck-Boost converters; Ćuk converter steady-state operation in CCM & DCM; PWM, closed-loop, feedforward, and current-mode control.

List of Experiments

1. Design and Simulation of Non isolated DC-DC Converters.
2. Closed-loop control simulation of Buck–Boost Converter.

MODULE - II ISOLATED DC-DC CONVERTERS AND GATE DRIVER CIRCUITS 8

Topologies including Forward, Flyback, Push-Pull, Half-Bridge, and Full-Bridge; Uni-polar, Bipolar, and isolated gate driver configurations; simulation under closed-loop control

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List of Experiments

1. Simulation of Push–Pull / Half-Bridge Converter – switch stress and waveform analysis.
2. Modeling of Isolated Gate Driver Circuits for MOSFET/IGBT switching.

MODULE - III RESONANT CONVERTERS, SNUBBERS AND MAGNETICS 8

Principles of resonant converters; necessity and design of turn-on/turn-off snubber circuits; design of inductors and transformers for power electronics; snubber integration simulation.

List of Experiments

1. Simulation of Turn-ON and Turn-OFF Snubber Circuits.
2. Design and simulation of inductors/transformers for converter applications.

MODULE - IV INVERTER FUNDAMENTALS AND MODULATION TECHNIQUES 8

Three-phase inverter operation in rectifier/inverter modes; Uni-polar, Bipolar, and Sinusoidal PWM strategies; Space Vector Modulation (SVM) and multilevel inverter structures for harmonic reduction.

List of Experiments

1. Simulation of Single-Phase, Three-Phase Voltage Source Inverters and Multilevel Inverters.
2. Simulation of Multilevel Inverters using PWM techniques.

MODULE - V SEMICONDUCTOR SWITCHING DEVICES AND PRACTICAL IMPLEMENTATION 7

Switching behavior of MOSFETs and IGBTs; switching trajectories and loss analysis; implementation and performance testing of converters and inverters.

List of Experiment

1. Switching characteristic simulation of MOSFET and IGBT.
2. Simulation of IGBT switching characteristics.

MODULE - VI APPLICATIONS IN SUSTAINABLE ENERGY SYSTEMS 6

Integration of DC-DC and isolated converters in Solar PV systems; power conditioning in Wind Energy; Inverter systems for Grid-Integration and EV charging; case studies in sustainable automation.

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List of Experiment

1. MATLAB simulation of DC–DC converters for Solar PV systems with MPPT.
2. Simulation of inverter systems for grid-connected renewable energy applications.

Lab Requirement (for Batch of 30 Students)

1. Standalone Desktop PCs with licensed MATLAB – 15 Nos

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Robert W. Erickson, Dragan Maksimović "Fundamentals of Power Electronics", 3rd Edition, Springer, 2020
2. Ned Mohan" Power Electronics: A First Course", 1st Edition, Wiley, 2011
3. Muhammad H. Rashid "Power Electronics: Circuits, Devices and Applications", 5th Edition, Pearson, 2014
4. Bimal N. Bose "Power Electronics and Motor Drives: Advances and Trends", Academic Press, 2021
5. FredeINK Blaabjerg, Dan M. Ionel (Editors) "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications", Wiley-IEEE Press, 2014

REFERENCE BOOKS:

1. Daniel W. Hart – Power Electronics, McGraw-Hill Education, 1st Edition, 2010.
2. Philip T. Krein – Elements of Power Electronics, Oxford University Press, 2nd Edition, 2015.
3. Robert W. Erickson, Dragan Maksimovic – Fundamentals of Power Electronics, Springer, 2nd Edition, 2001.

WEB RESOURCES:

1. NPTEL Courses by IIT Professors:
   Power Electronics (IIT Madras)
   Power Electronics (IIT Bombay)
2. Power Electronics Lectures – IIT Kharagpur (Prof. S. Das)
3. Power Electronics by GATE Academy
4. Power Electronics – All About Electronics

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ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc19_ee37/preview?
2. https://onlinecourses.nptel.ac.in/noc21_ee01/preview
3. https://onlinecourses.nptel.ac.in/noc24_ee88/preview

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply the fundamental principles to design and analyze non-isolated DC-DC converters.(K3)
2. Apply the knowledge of isolated topologies and gate drivers for power electronic systems. (K3)
3. Analyze the design and performance of resonant converters, snubber circuits, and magnetic components (K4)
4. Analyze the inverter configurations and implement advanced modulation techniques for power flow control. (K4)
5. Apply the semiconductor device switching characteristics to optimize converter performance. (K3)
6. Analyze the integration of power electronic converters in real-world sustainable energy and EV applications.(K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	2	2
CO2	2	2	2	1	1	-	-	-	-	-	-	3	3
CO3	2	2	1	2	1	-	-	-	-	-	-	3	3
CO4	3	2	2	1	2	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-	-
CO6	1	1	3	2	1	-	-	-	-	-	-	3	3

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DOMAIN GROUP - I: POWER SYSTEMS

COURSE CODE: 24EEEL507	ENERGY EFFICIENT ILLUMINATION SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117103488	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 11				
PRE-REQUISITE COURSES	24EEPC201					

OBJECTIVES:

- To understand the fundamental concepts of illumination engineering, lighting sources and measurement techniques used in modern lighting systems.
- To apply the laws of illumination and lighting calculations to determine luminance, illumination levels and lamp efficiency for practical applications.
- To analyze interior and exterior lighting requirements by selecting suitable lamps, luminaires and lighting fixtures based on standards and energy efficiency.
- To design efficient lighting systems for residential, commercial, industrial and public spaces using appropriate illumination methods and layout techniques.
- To evaluate aesthetic, emergency and special-purpose lighting systems for hospitals, auditoriums, monuments, sports facilities and street lighting applications.
- To develop energy-efficient lighting solutions incorporating modern lighting technologies and intelligent lighting controllers such as dimmers, sensors and timers.

MODULE - I INTRODUCTION TO LIGHTING 7

Types of illumination, Day lighting, Artificial light sources- artificial lighting and total lighting, Quality of good lighting, Factors affecting the Physical processes, Incandescent and Halogen lamps, Fluorescent lamps, LPSV and HPSV lamps, mercury vapour lamps, metal halide lamps, LED lamps- modern trends and energy efficient lamp analysis.

MODULE - II MEASUREMENT OF LIGHTING 8

Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or

luminance, Laws of illumination, Inverse square law and Lambert's Cosine law, Illumination at horizontal and vertical plane from point source, Concept of polar curve, Calculation of luminance and illumination.

MODULE - III INTERIOR LIGHTING **7**

Maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation, Illumination required for various work planes, Types of fixtures - DLOR and ULOR, Selection of energy efficient lamp and luminance, Selection of utilisation factor, reflection factor and maintenance factor.

MODULE - IV EFFICIENT DESIGNING OF INTERIOR LIGHTING **7**

Determination of Lamp Lumen, Layout of lamp luminaire, Calculation of space to mounting height ratio, Indian standard recommendation and standards, Special feature for entrance, staircase, Corridor lighting and industrial building.

MODULE - V EXTERIOR LIGHTING **8**

Street lighting, Types of fixture, Requirements of good street lighting, Selection of lamp and luminaire, Calculation of illumination level available on road. Tunnel Lighting, Flood Lighting-Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, Calculation of space to mounting height ratio.

MODULE - VI AESTHETIC AND EMERGENCY LIGHTING **8**

Special Features of Aesthetic Lighting: Monument and statue lighting, Sports lighting, Hospital lighting, Auditorium lighting General Aspects of emergency lighting. Energy efficient sLighting controllers – dimmers, motion and occupancy sensors, photo sensors and timers.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Lighting by D.C .Pritchard,Latest Edition: 6th Edition, Routledge, originally released in 1999; reissued/reprinted in paperback in 2016.
2. Applied Illumination Engineering by Jack L. Lindsey, Latest Edition: 3rd Edition, Publisher/Year: The Fairmont Press / CRC Press, 2015 (with Scott C. Dunning added as a co-author).

REFERENCE BOOKS:

1. Introduction to the Design and Analysis of Building Electrical Systems by John H. Matthews,Latest Edition: 1st Edition,Publisher/Year: Van Nostrand Reinhold / Springer, 1993.

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2. Lamps and Lighting by M.A. Cayless,Latest Edition: 4th Edition,Publisher/Year: Routledge, originally released in 1996 and re-released in digital/print formats in 2012 (co-edited by J.R. Coaton).
3. Advanced Lighting Controls: Energy Savings, Productivity, Technology and Applications by Craig DiLouie, Latest Edition: 1st Edition, Publisher/Year: CRC Press / River Publishers, 2021 (re-issue).
4. Lighting Engineering: Applied Calculations by R. H. Simons and A. R. Bean, Latest Edition: 1st Edition, Publisher/Year: Routledge / CRC Press, 2020 (re-issue).

WEB RESOURCES:

1. https://www.cs.rit.edu/usr/local/pub/ncs/illum.pdf
2. https://www.zumtobel.com/PDB/teaser/EN/lichthandbuch.pdf

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=vZO09qL-vZs
2. https://www.youtube.com/watch?v=IhmyGDXjv9I
3. http://www.digimat.in/nptel/courses/video/107107582/L02.html

OUTCOMES:

At the end of this course, the students should be able to:

1. Evaluate the performance and energy efficiency of different lighting sources and illumination systems for various lighting applications.(K5)
2. Analyze and determine illumination parameters such as luminance, luminous flux and illumination levels using laws of lighting and photometric calculations.(K5)
3. Assess the suitability of interior lighting fixtures, luminaires and utilization factors for achieving effective and uniform lighting conditions.(K5)
4. Design energy-efficient interior lighting systems by applying illumination standards, lamp lumen calculations and layout techniques.(K6)
5. Develop exterior lighting schemes for streets, tunnels and flood lighting applications by selecting appropriate lamps, fixtures and mounting arrangements.(K6)
6. Create aesthetic and emergency lighting solutions integrated with modern lighting controllers, sensors and automation techniques for smart energy management.(K6)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	2	1	1	1	2	-	-	-	-	-	3	-
CO2	1	2	1	2	2	2	-	-	-	-	-	3	-
CO3	2	3	2	2	2	2	-	-	-	-	1	3	-
CO4	2	3	2	1	2	2	-	-	-	-	1	3	-
CO5	1	2	1	2	2	2	-	-	-	-	1	3	-
CO6	1	2	1	2	2	2	-	-	-	-	1	3	-

DOMAIN GROUP - I: POWER SYSTEMS

COURSE CODE: 24EEEL508	SUSTAINABLE POWER GENERATION	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 127103236	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 13				
PRE-REQUISITE COURSES	24EEPC201, 24EEPC401					

OBJECTIVES:

- Gain a comprehensive understanding of global and Indian energy scenarios and their environmental footprints.
- Develop the skills to technically evaluate solar, wind, hydro, and biomass power systems.
- Master the concepts of energy storage, power electronics, and the complexities of grid integration.
- Stay ahead of the curve by exploring smart grids, microgrids, green hydrogen, and electric vehicles.
- Acquire the tools to conduct techno-economic analyses and navigate Indian renewable energy policies.
- Apply theoretical knowledge to design, simulate and optimize real-world sustainable energy projects.

MODULE - I ENERGY SUSTAINABILITY FUNDAMENTALS 8

Need for sustainable generation - climate change imperatives - renewable energy mandates - decarbonization pathways.

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MODULE - II SOLAR POWER GENERATION SYSTEMS 8

Solar resource assessment - Global Horizontal Irradiance (GHI), Direct Normal Irradiance (DNI), solar geometry - site selection criteria- Photovoltaic technology- PV system configurations - Maximum Power Point Tracking (MPPT) algorithm-Solar thermal Collectors

MODULE - III WIND, HYDRO & BIOMASS POWER SYSTEMS 8

Wind turbines-Wind farm development-Small hydroelectric power-turbine selection-Biomass energy systems: biomass feedstocks - co-firing in coal plants - combined heat and power (CHP) systems.

MODULE - IV ENERGY STORAGE & GRID INTEGRATION 7

Power electronics for renewable energy-Energy storage technologies-Grid codes and standards: Central Electricity Authority (CEA) grid connection procedures - Microgrids and smart grids- Vehicle-to-Grid (V2G) integration - bidirectional charging standards (CHAdeMO, CCS).

MODULE - V ECONOMICS, POLICIES & CASE STUDIES 7

Techno-economic parameters -Financial analysis methods-Indian renewable energy policies-Site selection and comparative assessment -Case studies: Kurnool Ultra Mega Solar Park, Andhra Pradesh (1.5GW)—largest solar plant in India, grid integration challenges, tariff trends. Muppandal Wind Farm, Tamil Nadu (1.3GW)—high-capacity factor (>30%), wind corridor development. NTPC Biomass Co-firing Projects—coal plant retrofits with agricultural waste, emissions reduction, supply chain logistics. Rooftop Solar on College Campuses—design example, O&M, energy audit methodologies.

MODULE - VI ENVIRONMENTAL ASPECTS & EMERGING TRENDS 7

Environmental impact assessment (EIA)-Pollution control technologies- - Emerging sustainable technologies - AI & ML in RE—solar forecasting - Hybrid renewable plants—solar + wind + storage bundles, complementary generation profiles, optimized grid integration.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 2019.
2. T.K. Sunder Rajan, S. Hemamalini, and K. Ramaprabha, Non Conventional Energy Resources, Khanna Publishers, 2020.
3. P.K. Nag, Power Plant Engineering, Tata McGraw Hill, 3rd Edition, 2018.

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4. Soteris Kalogirou, Solar Energy Engineering: Processes and Systems, 2nd Edition, Elsevier, 2014.

REFERENCE BOOKS

1. Godfrey Boyle (Ed.), Renewable Energy: Power for a Sustainable Future, Oxford University Press, 3rd Edition, 2012.
2. IEEE Std 1547-2020, Standard for Interconnecting Distributed Energy Resources with Electric Power Systems, IEEE.
3. K.K. Ramalingam, Power Plant Engineering, Scitech Publications, 2019.
4. Bernhardt G.A. Skrotzki and William A. Vopat, Power Plant Engineering, McGraw Hill, 2018.

WEB RESOURCES

1. https://nptel.ac.in/courses/112105125 (Sustainable Power Generation Systems)
2. https://www.mnre.gov.in/ (Ministry of New & Renewable Energy)
3. https://cea.nic.in/ (Central Electricity Authority)
4. https://www.irena.org/ (International Renewable Energy Agency)
5. https://www.ren21.net/ (REN21 Global Status Report)

ONLINE RESOURCES

1. https://onlinecourses.nptel.ac.in/noc23_ge47/preview (Sustainable Power Generation - NPTEL)
2. https://www.udemy.com/course/renewable-energy/ (Renewable Energy on Udemy)

OUTCOMES:

At the end of this course, the students should be able to:

1. Examine energy sustainability concepts, carbon accounting, and environmental impacts of power generation technologies. (K4)
2. Analyze working principles, components, and performance metrics of solar, wind, hydro, and biomass generation systems. (K3)
3. Design basic renewable energy systems and evaluate grid integration requirements and stability.(K3)
4. Demonstrate energy storage technologies and power electronics interfaces for high renewable penetration. (K3)
5. Apply techno-economic evaluation methods (LCOE, NPV, IRR) for sustainable power projects (K3)

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6. Evaluate Indian renewable energy policies, standards, and emerging sustainable technologies. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	2	3
CO2	3	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	-	-	-	-	2	-	-	-	3	3
CO4	2	2	2	-	-	-	-	-	-	-	-	2	2
CO5	3	3	2	-	-	-	-	-	-	-	-	3	2
CO6	3	3	2	-	3	-	-	-	-	-	-	3	3

DOMAIN GROUP - I: POWER SYSTEMS

COURSE CODE: 24EEEL509	ENERGY ECONOMICS AND POLICY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 109106161	SYLLABUS VERSION 1.0	SDG NO. 7, 11				
PRE-REQUISITE COURSES	24EEPC401					

OBJECTIVES:

- To introduce the fundamental concepts of energy economics and energy systems.
- To provide knowledge on energy demand, supply, and pricing mechanisms.
- To familiarize students with national and international energy policies and regulations.
- To develop an understanding of renewable energy economics and sustainability practices.
- To expose students to emerging energy trends, challenges, and future policy perspectives.

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MODULE - I INTRODUCTION TO ENERGY ECONOMICS **7**

Energy as an economic good- Energy resources and classification- Role of energy in economic development- Overview of global and Indian energy scenarios

MODULE - II ENERGY DEMAND, SUPPLY AND FORECASTING **7**

Energy demand characteristics- Load curves and consumption patterns- Energy supply systems-Basic energy forecasting methods.

MODULE - III COSTING, PRICING AND ENERGY MARKETS **8**

Cost components of power generation. transmission and distribution-Tariff structures- Electricity pricing Introduction To power markets

MODULE - IV ENERGY POLICY AND REGULATORY FRAMEWORK **8**

Need for energy policy- Indian energy policy framework-Electricity Ac-. Role of regulatory commissions and government bodies.

MODULE - V RENEWABLE ENERGY ECONOMICS AND SUSTAINABILITY8

Economics of renewable energy technologies-Cost comparison with conventional source- Incentives and subsidies-Sustainability and environmental impacts.

MODULE - VI FUTURE ENERGY TRENDS AND POLICY CHALLENGES **7**

Energy transition and decarbonization-Energy security- Smart grids-Policy challenges and case studies.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Bhattacharyya, Subhes C. (2011). Energy Economics: Concepts, Issues, Markets and Governance. 1st Edition, Springer, London.
2. Schwarz, Peter M. (2023). Energy Economics. 2nd Edition, Routledge, New York.

REFERENCES:

1. Rubino, A., Sapio, A., & La Scala, M. (2020). Handbook of Energy Economics and Policy: Fundamentals and Applications for Engineers and Energy Planners. Elsevier, Amsterdam.
2. Krozer, Y. (2021). Economics of Renewable Energy. Springer, Cham.

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3. Sorensen, B. (2017). Renewable Energy: Physics, Engineering Environmental Impacts, Economics and Planning. 5th Edition, Elsevier, London.
4. Nersesian, R. L. (2016). Energy Economics: Markets, History and Policy. 1st Edition, Routledge, New York.
5. Sadler, T. R. (2022). Energy Economics: Science, Policy, and Economic Applications. Rowman & Littlefield, Maryland.

WEB REFERENCES:

1. International Energy Agency (IEA). Energy Economics and Policy Resources. https://www.iea.org
2. U.S. Energy Information Administration (EIA). Energy Explained – Economics and Markets. https://www.eia.gov/energyexplained

ONLINE RESOURCES:

1. https://www.coursera.org/learn/energy-production

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply fundamental concepts of energy economics to interpret real-world energy market scenarios. (K3)
2. Analyze energy demand and supply dynamics in various economic and policy contexts. (K4)
3. Analyze energy costing structures and pricing mechanisms in conventional and deregulated energy markets. (k4)
4. Apply energy policies and regulatory frameworks to evaluate their impact on energy markets and sustainability goals. (k3)
5. Utilize the economic viability and sustainability aspects of renewable energy systems. (K3)
6. Analyze emerging energy trends and future challenges in the global energy sector. (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	3	3
CO3	3	2	2	-	-	-	-	-	-	-	-	3	3
CO4	3	2	2	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	3	2
CO6	3	2	2	2	2	-	-	-	-	-	-	3	2

DOMAIN GROUP - I: POWER SYSTEMS

COURSE CODE: 24EEEL520	POWER SYSTEM TRANSIENTS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 7				
PRE-REQUISITE COURSES	24EEPC201, 24EEPC401					

OBJECTIVES:

- To understand the fundamentals of power system transients
- To analyse the generation of switching transients
- To examine capacitance switching and Ferro resonance phenomena
- To study the mechanism of lightning strokes
- To learn the propagation, reflection, and refraction of travelling waves
- To evaluate the impact of voltage transients

MODULE - I INTRODUCTION AND OVERVIEW OF TRANSIENTS 7

Importance of studying transients in power systems-Causes of transients-Types of power system transients-Effects of transients on power systems-Role of transient studies in system planning

MODULE - II TRANSIENTS IN RL AND RLC CIRCUITS 7

RL circuit transient with sine wave excitation-Double frequency transients-Basic transforms of RLC circuit transients

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MODULE - III SWITCHING TRANSIENTS **7**

Over voltages due to switching operations-Resistance switching – equivalent circuit for interrupting resistor current-Load switching – equivalent circuit and transient voltage waveforms-Normal and abnormal switching transients-Current suppression and current chopping-Effective equivalent circuit

MODULE - IV CAPACITANCE SWITCHING AND FERRO RESONANCE **8**

Capacitance switching – effect of source regulation-Capacitance switching with restrike and multiple restrikes-Illustration for multiple restriking transients-Ferro resonance phenomenon

MODULE - V LIGHTNING TRANSIENTS **8**

Formation of clouds and charge build up in thunderstorms-Mechanism and characteristics of lightning discharges-Models for lightning strokes-Factors for good line design-Protection using ground wires-Tower footing resistance-Interaction between lightning and power systems

MODULE - VI TRAVELING WAVES AND TRANSIENTS IN INTEGRATED SYSTEMS **8**

Traveling wave concept, step response, and Bewley's lattice diagram- Short line and kilometric fault-Line dropping and load rejection-Voltage transients on closing and reclosing lines-Switching surges in integrated systems-Qualitative application of EMTP for transient computation

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010
4. Gevork Gharehpetian, Atousa Yazdani & Behrooz Zaker – Power System Transients: Modelling, Simulation, and Applications, CRC Press, 2023

REFERENCES :

1. M. S. Naidu and V. Kamaraju, High Voltage Engineering, Tata McGraw-Hill Education, 5th Edition, 2013.
2. R. D. Begamudre, Extra High Voltage AC Transmission Engineering, Wiley Eastern Limited, 1986.

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3. Y. Hase, Handbook of Power System Engineering, Wiley India, 2012.
4. J. L. Kirtley, Electric Power Principles: Sources, Conversion, Distribution and Use, Wiley, 2012.
5. Neville R. Watson and Jos Arrillaga, Power Systems Electromagnetic Transients Simulation, The Institution of Engineering and Technology (IET), 2nd Edition, 2018.

WEB RESOURCES:

1. NPTEL (National Programme on Technology Enhanced Learning) – High Voltage Engineering, Power System Protection, and Transient Analysis. https://nptel.ac.in
2. EMTP Official Website – Information, tutorials, and documentation for Electromagnetic Transients Program (EMTP) used in transient studies. https://www.emtp.com
3. PSCAD – EMT Simulation Software – Learning resources, manuals, and example projects for transient simulations. https://www.pscad.com

ONLINE RESOURCES:

1. Coursera – Power System Analysis and Simulation – Specialized courses on transient stability, protection, and electromagnetic disturbances. https://www.coursera.org
2. EMTP-RV Learning Center – Tutorials, example projects, and documentation for transient analysis using EMTP software. https://www.emtp.com/resources

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply knowledge of power system transients to analyze their causes, classify their types, evaluate their effects, and implement appropriate measures in power system planning and design.[K3]
2. Analyse transient responses in RL and RLC circuits under various excitations and evaluate double-frequency transients.(K4)
3. Examine the switching transients, current chopping, and suppression techniques for improved system protection.(K4)
4. Interpret the capacitance switching and Ferro resonance effects and their impact on system voltage stability.(K4)
5. Apply the principles of lightning stroke mechanism and lightning surges to design suitable protective measures for transmission lines.(K3)

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6. Investigate the behavior of traveling waves and voltage transients in integrated power systems by analyzing fault conditions and switching surges through EMTP simulations (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	1	-	-	-	-	-	-	2	2	-
CO2	3	3	2	3	-	-	-	-	-	-	2	2	-
CO3	3	3	2	3	-	-	-	-	-	-	2	2	-
CO4	3	3	2	3	-	-	-	-	-	-	2	2	-
CO5	3	3	3	1	-	-	-	-	-	-	2	2	-
CO6	3	3	2	3	-	-	-	-	-	-	2	2	-

DOMAIN GROUP - I: POWER SYSTEMS

COURSE CODE: 24EEEL521	ENERGY CONVERSION AND STORAGE TECHNIQUES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 103103222	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11				
PRE-REQUISITE COURSES	24EEPC401					

OBJECTIVES:

- To understand the need for energy conservation and efficient energy conversion
- To study various conventional and non-conventional energy conversion systems
- To analyze electrical and electrochemical energy storage technologies
- To understand thermal energy storage and mechanical energy storage methods
- To learn recent advances in energy storage for electric vehicles and grid applications
- To create awareness on sustainable and clean energy solutions

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MODULE – I ENERGY CONSERVATION FUNDAMENTALS **7**

Energy scenario – Energy demand and supply – Energy resources and classification – Principle of energy conservation – Energy efficiency and energy audit basics – Energy management concepts – Energy conservation opportunities in electrical systems – Standards and policies related to energy conservation

MODULE – II CONVENTIONAL & RENEWABLE ENERGY **8**

Conventional energy conversion systems – Thermal power plant: layout and working – Hydro power plant – Nuclear power plant – Renewable energy conversion systems – Solar energy conversion: photovoltaic and solar thermal – Wind energy conversion systems – Biomass and biogas energy conversion – Comparative analysis of energy sources.

MODULE – III ELECTROCHEMICAL ENERGY STORAGE SYSTEMS **7**

Energy storage fundamentals – Classification of energy storage systems – Batteries: lead-acid, nickel-cadmium, nickel-metal hydride – Lithium-ion batteries: construction, working and characteristics – Battery performance parameters – Battery management systems (BMS) – Applications of batteries in renewable energy systems.

MODULE – IV ELECTRICAL & MECHANICAL ENERGY STORAGE SYSTEMS8

Supercapacitors: principle, construction and applications – Flywheel energy storage – Compressed air energy storage (CAES) – Pumped hydro storage – SMES (Superconducting Magnetic Energy Storage) – Comparison of electrical and mechanical energy storage technologies.

MODULE – V THERMAL ENERGY STORAGE & HYDROGEN ENERGY **7**

Thermal energy storage: sensible heat storage, latent heat storage, phase change materials – Chemical energy storage – Hydrogen energy systems – Hydrogen production methods – Fuel cells: types, working principle and applications – Role of hydrogen in future energy systems.

MODULE – VI ADVANCED ENERGY STORAGE & APPLICATIONS **8**

Energy storage for electric vehicles – Grid-scale energy storage – Hybrid energy storage systems – Integration of renewable energy with storage – Smart grid and energy storage – Challenges and future trends in energy conversion and storage technologies – Environmental and economic aspects.

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. Ibrahim Dincer and Marc A. Rosen, Thermal Energy Storage: Systems and Applications, Wiley, Second Edition, 2011.

REFERENCES

1. Robert A. Huggins, Energy Storage, Springer, First Edition, 2010.
2. Bent Sørensen, Renewable Energy: Physics, Engineering, Environmental Impacts, Academic Press, Fifth Edition, 2017.
3. C. K. Thulasi Raman and P. Arunachalam, Energy Conservation and Management, New Age International, Second Edition, 2015.

WEB RESOURCES:

1. https://nptel.ac.in
2. https://www.energy.gov
3. https://www.iea.org
4. https://www.sciencedirect.com
5. https://www.renewableenergyworld.com

ONLINE RESOURCES:

1. https://nptel.ac.in
2. https://www.coursera.org
3. https://www.edx.org

OUTCOMES:

At the end of this course, the students should be able to:

1. Explain the fundamentals of energy conservation and management (K3)
2. Describe conventional and renewable energy conversion systems (K3)
3. Analyze electrochemical energy storage technologies (K4)
4. Compare electrical, mechanical and thermal energy storage systems (K4)
5. Explain hydrogen energy and fuel cell technologies (K3)
6. Apply energy storage concepts to electric vehicles and grid applications (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	1	2
CO2	3	2	2	1	-	-	-	-	-	-	-	2	2
CO3	3	2	2	1	-	-	-	-	-	-	-	1	2
CO4	2	2	2	1	-	-	-	-	-	-	-	1	2
CO5	2	2	2	1	-	-	-	-	-	-	-	1	2
CO6	3	2	2	1	-	-	-	-	-	-	-	1	2

DOMAIN GROUP - I: POWER SYSTEMS

COURSE CODE: 24EEEL522	POWER PLANT ENGINEERING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112107291	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 13				
PRE-REQUISITE COURSES	24EEPC401					

OBJECTIVES:

- To introduce the fundamental thermodynamic principles of Rankine cycle modifications and the detailed layout and subsystems of modern coal-fired thermal power plants.
- To provide an understanding of the operational principles, performance parameters, and optimization techniques for diesel, gas turbine, and combined cycle power plants.
- To familiarize students with various nuclear reactor types, their structural layouts, and essential safety protocols required for nuclear power generation.
- To explore the design, working principles, and integration of hydroelectric and prominent renewable energy technologies, including wind, solar, and tidal power systems.
- To impart knowledge on the economic principles of power generation, load curve analysis, and the technical criteria used for power plant site selection.
- To educate students on the environmental impacts of various power plants and the engineering methods used for pollution control and waste management.

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MODULE - I COAL BASED THERMAL POWER PLANTS 8

Rankine cycle — improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers. Turbines, Condensers, Steam & Heat rate. Subsystems of thermal power plants — Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

MODULE - II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 7

Otto, Diesel, Dual & Brayton Cycle — Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

MODULE - III NUCLEAR POWER PLANTS 7

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants. Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU). Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

MODULE - IV HYDRO AND RENEWABLE ENERGY POWER PLANTS 8

Hydro Electric Power Plants — Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

MODULE - V ECONOMICS OF POWER PLANTS 8

Power tariff types, Load distribution parameters, load curve. Comparison of site selection criteria, relative merits & demerits. Capital & Operating Cost of different power plants.

MODULE - VI ENVIRONMENTAL ISSUES AND POLLUTION CONTROL 7

Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants- Case study. Environmental impact assessment, scrubbers, electrostatic precipitators, nuclear waste management systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Arora S.C. and S. Domkundwar, A Course in Power Plant Engineering, Dhanpat Rai & Sons, 5th Edition, 2018.

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2. P.K. Nag, Power Plant Engineering, Tata McGraw Hill Education, 3rd Edition, 2018.

REFERENCE BOOKS

1. G.D. Rai, A Course in Power Plant Engineering, Khanna Publishers, 2012.
2. El-Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2017.
3. K.K. Ramalingam, Power Plant Engineering, Scitech Publications, 2019.
4. P.C. Roy and S. Choudhary, Power Plant Engineering, Standard Publications, 2020.
5. Bernhardt G. A. Skrotzki and William A. Vopat, Power Plant Engineering, McGraw Hill, 2018.

WEB RESOURCES

1. https://www.electrical4u.com/power-plant-engineering/
2. https://www.irena.org/energytransition/Technology/Power-plants

ONLINE RESOURCES

1. https://nptel.ac.in/courses/112105125
2. https://onlinecourses.nptel.ac.in/noc19_ee35/preview
3. https://nptel.ac.in/courses/112/105/112105125/

OUTCOMES:

At the end of this course, the students should be able to:

1. Examine Rankine cycle modifications and subsystems of modern coal thermal power plants.(K4)
2. Analyze performance of diesel, gas turbine and combined cycle power plants. (K4)
3. Demonstrate nuclear reactor types, layouts and safety measures. (K3)
4. Illustrate hydroelectric and various renewable energy power generation systems. (K4)
5. Apply economic evaluation methods for different power plant technologies. (K3)
6. Infer environmental pollution control technologies for power plants.(K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	2	1
CO2	2	3	2	-	-	-	-	-	-	-	-	3	2
CO3	2	2	1	-	-	-	-	-	2	-	-	2	2
CO4	2	2	-	-	-	-	-	-	-	-	-	2	2
CO5	2	3	2	-	-	-	-	-	-	-	-	3	2
CO6	3	3	2	-	-							3	3

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DOMAIN GROUP - II: ELECTRIC VEHICLES

COURSE CODE: 24EEEL510	FUNDAMENTALS OF THERMAL MANAGEMENT IN EVS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 7				
PRE-REQUISITE COURSES	24BSPH101, 24EEPC302, 24EEPC402					

OBJECTIVES:

- To understand the global energy scenario and describe the fundamentals of electric vehicles, radiation characteristics, and measurement techniques.
- To interpret EV architecture and estimate thermal radiation under varying climatic conditions.
- To analyze the working principles and performance of electric vehicles and thermal management systems.
- To summarize the operation, characteristics, and performance parameters of different control techniques for BMS
- To apply power electronic converters and control techniques for the effective operation of HVAC integration.
- To design and evaluate BMS based on load requirements, resource availability, and reliability constraints

MODULE - I INTRODUCTION TO EV THERMAL LOADS AND HEAT SOURCES 7

Overview of thermal challenges in EVs-Identification of key heat sources: motors, inverters, batteries-Typical thermal load profiles in EV operations-Basic thermodynamic principles in EV context

MODULE - II HEAT TRANSFER MECHANISMS AND ESTIMATION METHODS 7

Conduction, convection, and radiation fundamentals- Analytical and empirical methods for thermal load estimation-Thermal resistance networks and calculations-Use of software tools for thermal analysis

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MODULE - III BATTERY THERMAL MANAGEMENT TECHNIQUES 8

Battery temperature impact on performance and safety-Passive cooling systems: air, PCM-Active cooling systems: liquid, refrigerant-based-Thermal runaway prevention and containment

MODULE - IV MOTOR AND INVERTER COOLING SYSTEMS 7

Loss generation in electric motors and inverters-Internal vs external cooling strategies-Direct vs indirect cooling methods-Case studies on motor/inverter cooling designs

MODULE - V HVAC INTEGRATION AND HEAT EXCHANGER DESIGN 8

Role of HVAC in passenger comfort and thermal balance-Heat exchanger types and selection criteria-Integration of cabin cooling with component cooling-Design and layout considerations for compact systems

MODULE - VI SIMULATION TOOLS, FAILURES, AND SAFETY PRACTICES 8

Overview of thermal simulation tools (e.g., ANSYS, GT-SUITE, Simulink)-Case studies of real-world EV thermal failures-Safety standards related to thermal management-Fault diagnosis and thermal system protection strategies

TOTAL : 45 PERIODS

TEXT BOOKS:

1. M.D. Burghardt and J.B. Franzini , "Engineering Thermodynamics", 4th Edition, HarperCollins College Publishers, New York, 1993.
2. Yilmaz, M. and Krein, P.T., "Review of Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-in Electric and Hybrid Vehicles," IEEE Transactions on Power Electronics, Vol. 28, No. 5, pp. 2151–2169, 2013.

REFERENCE BOOKS:

1. Dincer, I. and Zamfirescu, C. "Thermal Energy Storage: Systems and Applications", 2nd Edition, Wiley, Hoboken, NJ, 2016.
2. Pistoia, G. (Ed.), "Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and the Market", 1st Edition, Elsevier, Amsterdam, 2010.

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OUTCOMES:

At the end of this course, the students should be able to:

1. Analyze the thermal challenges in electric vehicles and identify the major heat sources by applying basic thermodynamic principles(K3).
2. Apply heat-transfer principles to estimate thermal loads and construct thermal-resistance networks for EV components (K3).
3. Analyze battery thermal behavior and select appropriate passive and active battery thermal management techniques (K4).
4. Evaluate cooling strategies for electric motors and inverters based on loss mechanisms and operating conditions (K4).
5. Design and integrate HVAC and heat exchanger systems considering thermal balance, packaging, and efficiency (K4).
6. Use thermal simulation tools to analyze EV thermal systems and recommend safety and fault-protection measures (K3).

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	-	-	-	1	-
CO2	3	3	2	-	-	-	-	-	-	-	-	1	-
CO3	3	3	3	-	-	1	-	-	-	-	-	1	-
CO4	3	3	3	-	-	-	-	-	-	-	-	2	-
CO5	2	2	3	-	-	1	-	-	-	1	1	1	-
CO6	2	3	2	-	-	2	-	-	-	2	2	2	-

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DOMAIN GROUP - II: ELECTRIC VEHICLES

COURSE CODE: 24EEEL511	ELECTRICAL MACHINE DESIGN	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117103488	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24EEPC301, 24EEPC402					

OBJECTIVES:

- To introduce the fundamental principles, materials, thermal considerations, and magnetic circuit laws that form the foundation of electrical machine design.
- To explain the relationship between output equations, specific loadings, and main dimensions for different types of rotating machines and transformers.
- To impart knowledge of the core design procedures to calculate main dimensions, winding particulars, and performance parameters for DC machines.
- To familiarize students with the output equations and analyze operating characteristics for induction motors.
- To develop understanding of synchronous machines, main dimensions, design of salient pole machines.
- To design electrical machines using software tools.

MODULE - I INTRODUCTION OF ELECTRICAL MACHINE DESIGN 7

Major considerations in Electrical Machine Design – Materials for Electrical apparatus – thermal considerations, heat flow, temperature rise, rating of machines – Design of Magnetic circuits – Magnetising current – Calculation of MMF Leakage in Armature– Design of lap winding and wave winding- Design of permanent magnets- Design of field system-Design of solenoid, relay- Design of Field Windings.

MODULE - II DESIGN OF TRANSFORMERS 7

Construction - KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers. Computer program: Complete Design of single phase core transformer - Design of high frequency transformers for wireless charging in EV applications.

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MODULE - III DESIGN OF DC MACHINES **7**

Construction - Output Equation – Main Dimensions – Choice of specific loadings – Selection of number of poles – Design of Armature – Design of commutator and brushes – Design of field- Computer program: Design of Armature main dimensions, Design of Permanent Magnet DC motors for EV applications.

MODULE - IV DESIGN OF INDUCTION MOTORS **8**

Construction - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor – Operating characteristics- Magnetizing current - Short circuit current–rules for selecting rotor slots of squirrel cage machines– Circle diagram Computer program: Design of slip-ring rotor, Design of induction motors for EV applications.

MODULE - V DESIGN OF SYNCHRONOUS MACHINES **8**

Output equation – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor – Determination of full load field mmf – Design of field winding – Design of turbo alternators Computer program: Design of Stator main dimensions - Design of PMSM and Brushless DC Machines for EV applications.

MODULE - VI COMPUTER AIDED DESIGN **8**

Introduction to computer aided design- Limitations of traditional designs – Analysis and synthesis methods – hybrid techniques–Introduction to machine design softwares using Finite Element Method–Design, simulation and optimization using electromagnetic field simulation software-variables, constraints and objective function, problem formulation.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', 5 th Edition, Dhanpat Rai & Sons, New Delhi, 1984.
2. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Ltd, 2011.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', 2 nd Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2009.

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4. Ramamoorthy M. "Computer Aided Design of Electrical Equipment", East-West Press.
5. M. N. O. Sadiku, "Numerical techniques in Electromagnetics", CRC Press Edition,2001.
6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.

REFERENCE BOOKS:

1. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.
2. Balbir Singh 'Electrical Machine Design', Vikas Publishing House Private Limited, 1981.
3. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" 3rd Edition, CRC Press, Taylor & Francis Group, 2021.

WEB RESOURCES:

1. https://www.iea.org/topics/electric-vehicles
2. https://motoranalysis.com
3. http://www.femm.info
4. https://www.ansys.com/products/electronics/ansys-maxwell

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_ee50/preview
2. https://onlinecourses.nptel.ac.in/noc23_ee140/preview

OUTCOMES:

At the end of this course, the students should be able to:

1. Analyze the major considerations in electrical machine design, including thermal limits and ratings (K3)
2. Apply design equations to calculate dimensions and parameters of transformers(K3)
3. Determine the main dimensions of DC machines, design the armature. (K3)
4. Design the stator and rotor of induction motors, and formulate designs suitable for EV traction.(K4)

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5. Analyze the stator and rotor of synchronous machines, design of field winding, rotor design. (K4)
6. Design and simulate electrical machines using CAD and FEM-based software tools. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	1	2	1
CO2	3	2	3	-	-	-	-	-	-	-	1	2	2
CO3	3	2	3	-	-	-	-	-	-	-	1	3	3
CO4	3	2	3	-	-	1	-	-	-	-	2	3	3
CO5	3	2	3	-	-	1	-	-	-	-	2	3	3
CO6	3	2	3	-	2	1	-	-	-	-	3	3	3

DOMAIN GROUP - II: ELECTRIC VEHICLES

COURSE CODE: 24EEEL523	AUTONOMOUS VEHICLE SYSTEM	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 9, 11, 13				
PRE-REQUISITE COURSES	24ESEE401					

OBJECTIVES:

- To provide a comprehensive understanding of the evolution, architecture, vehicle dynamics, and key challenges of autonomous vehicle systems.
- To develop knowledge of sensor technologies, calibration methods, and perception techniques for environment sensing and object recognition..
- To equip students with localization and mapping techniques, including GNSS-based positioning and SLAM algorithms for autonomous navigation.
- To introduce global and local path planning algorithms and decision-making strategies used in autonomous vehicles.
- To develop competence in longitudinal and lateral vehicle control methods, including classical and advanced control strategies.

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- To familiarize students with V2X communication, safety standards, cybersecurity concerns, validation processes, and emerging trends in autonomous vehicle systems.

MODULE – I INTRODUCTION TO AUTONOMOUS VEHICLE SYSTEMS 8

Evolution of autonomous vehicles-Levels of driving automation (SAE J3016)-Autonomous vehicle architecture: sensing, perception, decision, control, and actuation-Vehicle dynamics overview (longitudinal and lateral dynamics)-On-board computing platforms and real-time constraints-Comparison between ADAS and fully autonomous systems- Challenges in autonomous driving: environment, safety, reliability, ethics.

MODULE - II SENSORS AND PERCEPTION SYSTEMS 7

Sensor types and characteristics-LiDAR, RADAR, ultrasonic sensors

Sensor calibration and synchronization - Sensor fusion techniques (low-level and high-level fusion)-Object detection and classification -Lane detection and free-space estimation- Road and traffic sign recognition

MODULE - III LOCALIZATION AND MAPPING 8

Coordinate frames and transformations- Map representations (metric maps, HD maps-Localization technique-GNSS-based localization-Simultaneous Localization and Mapping (SLAM) - Kalman Filter, Extended Kalman Filter, Particle Filter-Map matching and real-time localization challenges

MODULE - IV PATH PLANNING AND DECISION MAKING 7

Motion planning problem formulation , Global path planning algorithms-Dijkstra A, , Hybrid A ,Local path planning algorithms- RRT, Dynamic Window Approach -Trajectory generation and optimization- Rule-based vs learning-based decision making

MODULE - V VEHICLE CONTROL AND ACTUATION 8

Longitudinal control (throttle and braking control)- Lateral control (steering control)-Classical control methods-PID control,State-space control -Model Predictive Control (MPC) for autonomous vehicles . Actuator dynamics and constraints.

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MODULE - VI CONNECTIVITY, SAFETY, AND VALIDATION **7**

Vehicle-to-Everything (V2X) communication- Cooperative autonomous driving-Cybersecurity and data privacy issues-Functional safety standards (ISO 26262)-Safety of the Intended Functionality (SOTIF – ISO 21448)-Testing- Future trends: AI-driven autonomy, autonomous EVs, smart cities

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rajkumar, R., Mawal, S., Behere, S., & Gopalan, S. "Autonomous Driving: Technical, Legal and Social Aspects" Springer, 1st Edition, 2016
2. Thrun, S., Burgard, W., Fox, D."Probabilistic Robotics",MIT Press, 1st Edition, 2005

REFERENCES

1. LaValle, S. M."Planning Algoriths",Cambridge University Press, 1st Edition, 2006
2. Falcone, P., et al."Predictive Control for Autonomous Driving "Springer, 1st Edition, 2018
3. Zeliski, R. " Computer Vision- Algorithms and Applications",Springer, 2nd Edition, 2022
4. Goodfellow, I., Bengio, Y., Courville, A. Deep Learning,MIT Press, 1st Edition, 2016
5. Weisong Shi , Yuankai He,Introduction to Autonomous Driving,Springer Nature, 2026

WEB RESOURCES:

1. https://developer.nvidia.com/drive/simulation
2. https://www.sae.org/standards/content/j3016_202104/
3. https://www.iso.org/standard/70939.html

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/self-driving-cars
2. https://www.coursera.org/learn/ai-for-autonomous-vehicles-and-robotics
3. https://www.edx.org/learn/technology/eth-zurich-self-driving-cars-with-duckietown
4. https://www.classcentral.com/subject/autonomous-driving
5. https://www.mooc-list.com/tags/autonomous-vehicles

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OUTCOMES:

At the end of this course, the students should be able to:

1. Apply the architecture, operational levels, and fundamental components of autonomous vehicle systems in autonomous driving applications. (K3)
2. Analyze different sensors and perception techniques used for environment sensing and object detection, and present the analysis through technical reports or discussions. (K4))
3. Apply localization and mapping algorithms to estimate vehicle position in real-world driving scenarios collaboratively in team-based projects. (K3)
4. Apply path planning and decision-making algorithms for autonomous navigation in simulated or real-world scenarios.(K3)
5. Analyze vehicle control strategies to achieve safe and stable autonomous driving performance and communicate the outcomes effectively. (K4)
6. Apply safety standards, communication protocols, and validation procedures in autonomous vehicle systems considering regulatory and ethical constraints.(K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	2	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	2	3	2	2	-	-	-	-	-	1	3	-
CO4	-	3	3	2	-	-	-	-	-	2	1	2	2
CO5	3	3	3	1	3	-	-	2	1	-	1	3	3
CO6	-	-	3	1	-	3	-	-	-	2	-	2	2

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DOMAIN GROUP - II: ELECTRIC VEHICLES

COURSE CODE: 24EEEL524	CHARGING INFRASTRUCTURE	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108107715	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11				
PRE-REQUISITE COURSES	24EEPC201, 24EEPC303, 24EEPC304					

OBJECTIVES:

- To understand the electric vehicle (EV) charging ecosystem and its evolution
- To study EV charging standards, protocols and interoperability requirements
- To analyze onboard and offboard charger design and operation
- To understand charging infrastructure planning and grid integration
- To study wireless charging technologies and standards
- To introduce business models, cybersecurity and smart charging concepts

MODULE – I OVERVIEW OF EV CHARGING ECOSYSTEM 8

Evolution of EV charging technologies – Classification of charging systems: AC Level 1 and Level 2, DC fast charging, ultra-fast charging – EVSE architecture and components: plug, cable, control box, metering unit – Vehicle-side interface versus grid-side interface – Interoperability and vehicle compatibility considerations.

MODULE – II CHARGING STANDARDS AND PROTOCOLS 8

Detailed study of international charging standards – IEC 61851 and IEC 62196 – CHAdeMO, CCS and GB/T standards – Plug types and connector specifications – ISO 15118 Plug & Charge communication protocol – Open Charge Point Protocol (OCPP) and versions – Backend management and monitoring – Interoperability testing and certification bodies.

MODULE – III ONBOARD AND OFFBOARD CHARGER DESIGN 7

Onboard and offboard charger architecture – Hardware components and operating principles – Converter topologies: unidirectional and bidirectional chargers – Charging algorithms – Power factor correction techniques – Thermal management of chargers – Safety mechanisms, protection and fault handling

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MODULE – IV CHARGING NETWORK PLANNING 7

Charging infrastructure planning concepts – Site selection criteria for urban and rural areas – Load forecasting and time-of-use management – Grid integration of charging stations – Peak load handling strategies – Integration with renewable energy sources and battery storage – GIS-based infrastructure planning tools.

MODULE – V WIRELESS AND INDUCTIVE CHARGING 8

Principles of inductive and resonant magnetic coupling – Stationary and dynamic wireless charging – Coil design and alignment issues – Efficiency considerations – Charging power levels – Standards for wireless charging: SAE J2954 and IEC 61980 – Electromagnetic field (EMF) safety and shielding requirements.

MODULE – VI BUSINESS MODELS AND CYBERSECURITY 7

EV charging business models – Public, private and fleet charging – Pricing strategies and subscription-based platforms – Smart charging and demand response – Load management techniques – Cybersecurity threats in EVSE – Security countermeasures – Payment integration, authentication and billing systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Khalid Syed, James Larminie and John Lowry, Electric Vehicle Technology Explained, Wiley, Third Edition, 2022.
2. Seref Sagiroglu, Tuncer Bayram and Selcuk Ozdemir, Smart Charging Technologies for Electric Vehicles, CRC Press / Taylor & Francis, 2019.

REFERENCES

1. International Energy Agency (IEA), EV Charging Infrastructure Report, 2023.
2. IEEE Transactions on Transportation Electrification, Selected Recent Papers.
3. Chris Mi, M. Abul Masrur and David Wenzhong Gao, Modern Electric Vehicle Technology, Wiley–IEEE Press, Second Edition, 2021.

WEB RESOURCES:

1. https://www.youtube.com/watch?v=gK2k7gMjqmY&t=18s
2. https://www.youtube.com/watch?v=mg6y_g7-FOg&t=14s

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ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc25_ee134/preview

OUTCOMES:

At the end of this course, the students should be able to:

1. Explain the EV charging ecosystem and charging technologies (K3)
2. Describe international EV charging standards and communication protocols (K3)
3. Analyze onboard and offboard charger design and operation (K4)
4. Apply charging network planning concepts for real-world deployment (K4)
5. Explain wireless EV charging principles and standards (K3)
6. Evaluate using case study of business models and cybersecurity aspects of EV charging infrastructure (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	1	2
CO2	3	2	2	-	-	-	-	-	-	-	-	2	2
CO3	3	2	3	-	-	-	-	-	-	-	-	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	1	2
CO5	2	2	2	-	-	-	-	-	-	-	-	1	2
CO6	3	2	2	-	-	-	-	2	-	2	-	1	2

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DOMAIN GROUP - II: ELECTRIC VEHICLES

COURSE CODE: 24EEEL525	BATTERY TECHNOLOGIES AND MANAGEMENT SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 7, 12				
PRE-REQUISITE COURSES	24EEPC201					

OBJECTIVES:

- To Understand the fundamentals of batteries and their chemistry.
- To Learn the architecture and key functions of Battery Management Systems (BMS).
- To Analyze the techniques used to estimate battery states like SoC and SoH.
- To Apply BMS protection, control strategies, and balancing techniques.
- To Understand BMS communication protocols and integration in applications.
- To Design, simulate, and analyze BMS using case studies and software tools.

MODULE - I INTRODUCTION TO BATTERY TECHNOLOGIES 7

Basics of electrochemistry - Battery cell types: Li-ion, Lead Acid, NiMH, Solid-state - Battery characteristics: capacity, C-rate, SoC, DoD, efficiency - Battery applications: EVs, renewable energy storage, consumer electronics - Comparison of different chemistries for BMS design

MODULE - II FUNDAMENTALS OF BATTERY MANAGEMENT SYSTEMS 7

Role and importance of BMS - Architecture of BMS: centralized, distributed, modular - Functional blocks of BMS - Key parameters monitored by BMS (SoC, SoH, temperature, current, voltage) - Standards and safety requirements (ISO 26262, UL, IEC standards)

MODULE - III STATE ESTIMATION TECHNIQUES 7

State of Charge (SoC) estimation methods: Coulomb counting, Open Circuit Voltage (OCV), Kalman Filter and Extended Kalman Filter (EKF) - State of Health (SoH) estimation techniques - Remaining Useful Life (RUL) prediction - Temperature estimation and thermal modeling

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MODULE - IV BATTERY PROTECTION AND CONTROL **8**

Over-voltage, under-voltage protection - Over-current, short circuit, and over-temperature protection - Cell balancing: passive vs active methods - Fault detection and diagnostic strategies - Battery safety protocols and fail-safe mechanisms

MODULE - V BMS COMMUNICATION AND INTEGRATION **8**

Communication protocols: CAN, LIN, SPI, I2C - BMS integration with vehicle systems (EVs/HEVs) - Interfacing with Battery Energy Storage Systems (BESS) - Cloud-based BMS monitoring and IoT integration - Firmware and real-time operating system (RTOS) for BMS

MODULE - VI BMS DESIGN, SIMULATION, AND CASE STUDIES **8**

BMS design considerations (hardware and software) - Simulation tools: MATLAB/Simulink, PLECS, LTspice - Thermal management design and simulation - Case studies on EV BMS, stationary BESS, and renewable integration - Emerging trends: AI in BMS, solid-state battery management

Optional Components

- Laboratory Sessions: Testing and interfacing Li-ion battery packs with a BMS
- Mini Project: Designing a simple BMS prototype or simulation
- Guest Lectures: Industry experts on EV BMS systems

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Gregory L. Plett, Battery Management Systems, Volume I & II, Artech House, 2015.
2. H.J. Bergveld, W.S. Kruijt, P.H.L. Notten, Battery Management Systems: Design by Modelling, Springer, 2002.

REFERENCES:

1. Chris Mi, M. Abul Masrur, Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Wiley, 2011.
2. Phil Weicker, A Systems Approach to Lithium-Ion Battery Management, Artech House, 2013.
3. A. Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
4. Research papers from IEEE, ScienceDirect, and other journals on BMS and battery technology.

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OUTCOMES:

At the end of this course, the students should be able to:

1. Explain the working principles and characteristics of batteries. (K3)
2. Describe the architecture and functionalities of BMS.(K3)
3. Analyze and implement battery state estimation techniques. (K4)
4. Apply protection and control mechanisms in BMS.(K3)
5. Evaluate BMS communication systems and integration methods. (K4)
6. Design and simulate BMS using case studies and engineering tools.(K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	2	-	-	-	-	-	-	2	-
CO3	3	3	2	3	2	-	-	-	-	-	-	3	2
CO4	3	2	3	2	3	-	-	-	-	-	-	3	2
CO5	3	2	3	2	2	-	-	-	-	-	-	3	2
CO6	3	3	3	3	3	-	-	-	-	-	-	3	3

DOMAIN GROUP - II: ELECTRIC VEHICLES

COURSE CODE: 24EEEL504	SPECIAL ELECTRICAL MACHINES – LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 12				
PRE-REQUISITE COURSES	24EEPC302, 24EEPC402					

OBJECTIVES:

- To understand the classification, features, and applications of special electrical machines.
- To explain the construction and working principles of stepper motors used in automation systems.
- To analyze the operating characteristics and control of Switched Reluctance Motors.
- To apply electronic commutation principles in BLDC motors.

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- To analyze the performance and control techniques of Permanent Magnet Synchronous Motors.
- To familiarize with linear and emerging electrical machines used in modern industrial and EV applications.

MODULE - I FUNDAMENTALS OF SPECIAL ELECTRICAL MACHINES 7

Classification and applications of special electrical machines – Basic electromagnetic torque production – Comparison with conventional machines.

List of Experiments

1. Measure and compare the torque–speed characteristics of stepper and BLDC motors.
2. Analyze speed, current, and torque characteristics under different loading conditions.

MODULE - II STEPPER MOTORS 8

Construction and operation of VR, PM, and Hybrid Stepper Motors – Excitation methods – Applications in automation systems.

List of Experiments

1. Demonstrate clockwise and anticlockwise rotation of a stepper motor using excitation sequences.
2. Determine and plot the torque–speed characteristics of a stepper motor.
3. Study step angle variation and positioning control of a stepper motor.

MODULE - III SWITCHED RELUCTANCE MOTORS (SRM) 8

Construction and working principle of SRM – Torque production – Basic drive and control methods – Industrial applications.

List of Experiments

1. Measure average torque and analyze torque ripple characteristics of an SRM.
2. Analyze speed and current characteristics of an SRM under varying load conditions.

MODULE - IV SYNCHRONOUS RELUCTANCE & BRUSHLESS DC (BLDC) MOTORS 8

Construction and operation of BLDC motors – Electronic commutation – Speed and torque control – Applications in EVs and home appliances.

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List of Experiments

1. Determine and analyze the torque–speed characteristics of a BLDC motor.
2. Study electronic commutation and direction control of a BLDC motor.

MODULE - V PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) **7**

Types and operation of PMSM – Torque–speed characteristics – Basic inverter-fed control methods – Applications in renewable energy and electric mobility.

List of Experiments

1. Control and analyze PMSM speed characteristics by varying inverter voltage and frequency.
2. Analyze PMSM performance under different loading conditions.

MODULE - VI LINEAR AND OTHER EMERGING MACHINES **8**

Basic operation and applications of Linear Induction Motors (LIM), Linear Synchronous Motors (LSM), Universal Motors, and emerging special machines.

List of Experiments

1. Measure and analyze thrust–speed characteristics of a linear motor.
2. Study the operational characteristics of a universal motor under varying voltage conditions.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Krishnan, R., Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications, CRC Press, 2017.
2. M.V. Deshpande, Design and Testing of Electrical Machines, PHI Learning, 2011.
3. T. J. E. Miller, Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science Publications, 1989.

REFERENCE BOOKS:

1. E.G. Janardanan, Special Electrical Machines, PHI Learning Pvt. Ltd., 2014.
2. K. Venkata Ratnam, Special Electrical Machines, Universities Press, 2019.
3. T.J.E. Miller, Switched Reluctance Motors and Their Control, Magna Physics Publishing and Oxford University Press, 1993.
4. D. C. Hanselman, Brushless Permanent Magnet Motor Design, McGraw-Hill, 2006.

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WEB RESOURCES

1. NPTEL - Special Electrical Machines (Prof. B.G. Fernandes, IIT Bombay)
2. IEEE Xplore – Special Machines in Electric Vehicles
3. MIT OpenCourseWare – Advanced Electric Machines

YOUTUBE LINKS

1. NPTEL Playlist - Special Electrical Machines
2. BLDC and PMSM Control Explained – RealPars
3. Stepper Motors Working Animation – Learn Engineering

OUTCOMES:

At the end of this course, the students should be able to:

1. Explain the classification, constructional differences, and applications of special electrical machines in comparison with conventional electrical machines. (K3)
2. Interpret the construction, working principles, and operational characteristics of VR, PM, and Hybrid stepper motors used in automation systems. (K3)
3. Analyze torque production, characteristics, and power electronic drive configurations of Switched Reluctance Motors. (K3)
4. Apply electronic commutation and control methods for BLDC motor drives in residential, industrial, and electric vehicle applications. (K3)
5. Illustrate phasor representation, torque characteristics, and vector control strategies of Surface-mounted and Interior PMSMs. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	1	-	2	3
CO2	3	3	2	2	1	-	-	-	1	-	-	2	3
CO3	3	3	2	2	2	-	-	-	-	-	-	3	3
CO4	3	2	3	2	3	-	1	-	1	-	-	3	3
CO5	3	3	2	2	2	-	-	-	-	1	-	3	3
CO6	3	2	1	-	-	-	-	-	-	-	-	2	2

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DOMAIN GROUP - II: APPLIED ELECTRONICS

COURSE CODE: 24EEEL512	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117103488	SYLLABUS VERSION 1.0	SDG NO. 3, 4, 9				
PRE-REQUISITE COURSES	24BSPH101, 24BSPH201					

OBJECTIVES:

- To Introduce the fundamentals of MEMS, microsystems and their multidisciplinary nature
- To familiarize the principles of microfabrication processes used in MEMS.
- To impart knowledge on MEMS-based devices for mechanical and electrical behavior.
- To impart knowledge on the working principles of MEMS sensors.
- To develop understanding of MEMS actuators.
- To create awareness of real-world MEMS applications.

MODULE - I INTRODUCTION TO MEMS 7

Overview of MEMS and microsystems – Historical development – intrinsic characteristics of MEMS - elements of MEMS: micro sensors and micro actuators - Advantages and limitations of MEMS – Scaling laws – Materials for MEMS: silicon, polymers, metals, ceramics.

MODULE - II MEMS FABRICATION TECHNOLOGY 8

Photolithography – Oxidation – Diffusion – Ion implantation – Thin film deposition: PVD, CVD – Etching techniques: wet and dry etching – Bulk micromachining – Surface micromachining – LIGA process.

MODULE - III ELECTRICAL AND MECHANICAL CONCEPTS 8

Electrical concepts: semiconductor materials, calculation of charge carrier concentration, conductivity and resistivity of semiconductor.

Mechanical concepts: Crystal planes and orientation, Internal force analysis, mechanical properties of silicon and related thin films, flexural beam bending analysis under simple loading conditions, torsional deflections, spring constant and resonant frequency.

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MODULE - IV MEMS SENSORS 8

Classification of MEMS sensors – Electrostatic sensor, principle of parallel plate capacitors and its applications - Thermal sensor: Fundamentals of thermal transfer, thermal bimorph principle - Piezoresistive sensor: Materials, piezoresistivity - Piezoelectric sensor: Materials and Piezoelectric effect - Pressure sensors – Accelerometers – Flow sensors.

MODULE - V MEMS ACTUATORS 7

Actuation using thermal forces, shape memory alloys, piezoelectric crystals, electrostatic forces (Parallel plate, torsion bar Comb drive actuators), Microgrippers and micromotors.

MODULE - VI CASE STUDIES OF MEMS 7

Case Studies of Mems Products - Blood Pressure Sensor - Microphone - Acceleration sensor - Top concerns for Mems product Development.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2011, 2nd Edition.
2. Tai-.Ran Hsu, "MEMS and Microsystems: design , manufacture, and Nanoscale"- 2nd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey, 2008.
3. Julian W Gardner and Vijay K Varadan, " Microsensors, MEMS and Smart Devices", John Wiley and Sons Ltd, 2001, 1st Edition

REFERENCE BOOKS:

1. Marc F madou" Fundamentals of micro fabrication" CRC Press 2002 2nd Edition Marc Madou.
2. M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes",Elsevier, Newyork, 16 Oct 2000, 1st Edition.
3. Maluf, Nadim "An introduction to Micro Electro-mechanical Systems Engineering "AR Tech house, Boston, June 30 2004, 2nd Edition.
4. Mohamed Gad – el – Hak "MEMS Handbook" Edited CRC Press 2001, 1st Edition.

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WEB RESOURCES:

1. ps://video.search.yahoo.com/search/video?fr=mcafee_e-27930_3pc-as&p=YOU+TUBE+VIDEO+FOR+MEMS+MICHRO+ELECTRO+MECHANICAL+SYSTEM&type=G210US885G91958Mb33b38d595cfd627d211e9e8fb63c1c9#id=11&vid=387512d009d3274af2518442d2387abe&action=click
2. ps://video.search.yahoo.com/search/video?fr=mcafee_e-27930_3pc-as&p=YOU+TUBE+VIDEO+FOR+MEMS+MICHRO+ELECTRO+MECHANICAL+SYSTEM&type=G210US885G91958Mb33b38d595cfd627d211e9e8fb63c1c9#id=36&vid=b944973ff5ca77f00e353ba1b7f5614d&action=view

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee36/preview
2. https://nptel.ac.in/courses/117105082
3. http://elearn.psgcas.ac.in/nptel/courses/video/117105082/L01.html

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply the fundamentals, scaling laws, and material properties of MEMS to explain the behavior of microsystems. (K3)
2. Apply MEMS fabrication processes such as photolithography, thin-film deposition, etching, and micromachining to outline process flows for MEMS devices.(K3)
3. Analyze electrical and mechanical characteristics of MEMS structures using semiconductor theory and mechanical modeling.(K4)
4. Analyze the working principles and performance characteristics of MEMS sensors based on electrostatic, thermal, piezoresistive, and piezoelectric effects. (K4)
5. Analyze various MEMS actuation mechanisms and determine their suitability for specific microsystem applications. (K4)
6. Analyze practical MEMS products and development challenges using case studies. (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	1	-	1
CO2	3	-	-	-	-	-	-	-	-	-	1	-	2
CO3	3	2	–	–	–	–	–	–	–	–	1	–	2
CO4	3	1	-	-	-	-	-	-	-	-	1	2	2
CO5	3	1	-	-	-	-	-	-	-	-	1	2	2
CO6	2	1	-	-	-	2	-	2	-	2	1	2	2

DOMAIN GROUP - II: APPLIED ELECTRONICS

COURSE CODE: 24EEEL513	GREEN ELECTRONICS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 12				
PRE-REQUISITE COURSES	24BSCY201, 24EEPC304					

OBJECTIVES:

- To introduce students to the concepts of green electronics, sustainability, environmental impact of electronic systems, and the need for eco-friendly design practices.
- To enable students to understand and apply energy-efficient techniques in electronic devices, circuits, and power management systems.
- To familiarize students with green power sources and energy harvesting techniques suitable for low-power electronic and IoT applications.
- To impart knowledge on sustainable materials, green manufacturing practices, environmental regulations, and eco-friendly electronic product design.
- To develop an understanding of energy-efficient communication, computing systems, and low-power IoT architectures for sustainable operation.
- To create awareness about e-waste management, recycling techniques, circular economy concepts, and emerging trends in green and sustainable electronics.

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MODULE - I INTRODUCTION TO GREEN ELECTRONICS 7

Need for Green Electronics -Environmental impact of electronic systems- Energy efficiency and sustainability concepts-Life cycle assessment (LCA) of electronic products- Green manufacturing and eco-design principles.

MODULE - II ENERGY-EFFICIENT ELECTRONIC DEVICES 7

Low-power electronic devices- Power-efficient semiconductor devices- Energy-efficient IC design techniques- Low-power CMOS design basics- Power management techniques.

MODULE - III GREEN POWER SOURCES AND ENERGY HARVESTING 7

Renewable energy sources for electronics -Energy harvesting methods: solar, thermal, vibration, RF- Micro-energy harvesting systems- Power conditioning circuits for harvested energy- Applications in IoT and embedded systems

MODULE - IV SUSTAINABLE MATERIALS AND MANUFACTURING 8

Green materials in electronics - RoHS and WEEE directives - Lead-free soldering techniques- Eco-friendly PCB design and fabrication - Recycling and reuse of electronic components

MODULE - V GREEN COMMUNICATION AND COMPUTING SYSTEMS 8

Energy-efficient communication systems -Green wireless networks and protocols- Low-power IoT architectures- Green data centers and cloud computing - Carbon footprint reduction in computing systems

MODULE - VI E-WASTE MANAGEMENT AND FUTURE TRENDS 8

E-waste generation and challenges- E-waste collection, recycling, and disposal methods- Circular economy in electronics- Government policies and standards for green electronics-Future trends: sustainable electronics, biodegradable electronics.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. S. L. Kakani & B. B. Bhattacharyya, Green Electronics Design and Manufacturing, Springer India, New Delhi, First Edition, 2016.
2. R. K. Rajput, Green Engineering and Sustainability, Laxmi Publications, New Delhi, First Edition, 2018.
3. B. H. Khan, Non-Conventional Energy Resources, McGraw Hill Education (India), New Delhi, Second Edition, 2017.

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REFERENCES:

1. P. S. Bimbhra, Power Electronics and Renewable Energy Systems, Khanna Publishers, New Delhi, First Edition, 2017.
2. S. A. Khaparde & Prabha Kundur, Sustainable Power Systems and Smart Grids, McGraw Hill Education (India), New Delhi, First Edition, 2019.
3. V. K. Jain & A. K. Ghosh, E-Waste Management and Environmental Sustainability, PHI Learning Private Limited, New Delhi, First Edition, 2019.
4. Sammy G Shina, "Green Electronics Design and Manufacturing", MC Graw Hill, 2008.
5. Mihai Irimia-Vladu, Eric D. Glowacki, Niyazi S. Sariciftci, Siegfried Bauer, "Green Materials for Electronics", Wiley, 2017.

WEB RESOURCES:

1. https://www.iea.org/
2. https://youtube.com/shorts/QaxfYJC9FrU?si=hrX48WKVRoIGX0Dc

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc25_me178/preview
2. https://www.coursera.org/learn/sustainability#modules
3. https://onlinecourses.swayam2.ac.in/cec26_cy04/preview
4. https://onlinecourses.swayam2.ac.in/ntr26_ed30/preview

OUTCOMES:

At the end of this course, the students should be able to:

1. Utilize the principles of green electronics to support sustainable development. [K3]
2. Make use of sustainable materials, green manufacturing practices, and environmental regulations in electronic system development. [K3]
3. Apply energy-efficient techniques in electronic devices and circuits. [K3]
4. Identify and analyze green power sources and energy harvesting methods for electronic systems. [K3]
5. Analyze green communication and computing systems for reduced energy consumption. [K4]
6. Analyze e-waste management practices and emerging trends in sustainable electronics, and develop a project proposal for an efficient and economically feasible e-waste management or sustainable electronics solution [K4]

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CO - PO, PSO MAPPING:

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CO1	2	2	-	-	-	2	-	-	-	-	2	2	-
CO2	2	2	-	-	-	2	-	-	-	-	2	2	-
CO3	2	2	-	-	-	1	-	-	-	-	2	2	-
CO4	2	2	-	-	-	2	-	-	-	-	2	2	-
CO5	2	2	-	-	-	2	-	-	-	-	2	2	-
CO6	2	2	-	-	-	2	-	2	-	2	2	2	-

DOMAIN GROUP - II: APPLIED ELECTRONICS

COURSE CODE: 24EEEL514	DIGITAL SIGNAL PROCESSING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108108185	SYLLABUS VERSION 1.0	SDG NO. 3, 4, 9				
PRE-REQUISITE COURSES	24BSMA201, 24ESEE401					

OBJECTIVES:

- To provide a strong foundation in Digital Signal Processing (DSP), including the representation and classification of discrete-time signals and systems.
- To develop the ability to analyze discrete-time signals and systems using mathematical tools such as the Z-transform and frequency-domain techniques.
- To enable understanding of the Discrete Fourier Transform (DFT), its properties, and spectral analysis of discrete-time signals.
- To impart knowledge of efficient DFT computation techniques through Fast Fourier Transform (FFT) algorithms, including DIT and DIF methods.
- To develop competence in the design, analysis, and realization of FIR and IIR digital filters to meet desired frequency-response specifications.
- To familiarize students with Digital Signal Processor (DSP) architectures and to enable the implementation of DSP algorithms for real-world engineering applications.

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MODULE - I BASIC ELEMENTS OF DIGITAL SIGNAL PROCESSING 8

Signals, Systems and Signal Processing - Classification of Signals,- mathematical representation of signals - spectral density - sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect - The Concept of Frequency in Continuous Time and Discrete Time Sinusoidal Signals.

MODULE - II ANALYSIS OF DISCRETE-TIME SIGNALS 7

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

MODULE - III COMPUTATION OF THE DFT – FFT ALGORITHMS 7

Discrete Fourier Transform - properties, Magnitude and phase representation - Computation of

DFT using FFT algorithm - DIT and DIF using radix 2 FFT - Butterfly structure.

MODULE - IV STRUCTURE OF IIR 8

Infinite Impulse response Filter Format - Bilinear Transformation Design Method - Analog Filters using Low pass prototype transformation - Normalized Butterworth Functions - Bilinear Transformation and Frequency Warping - Bilinear Transformation Design Procedure - Digital Butterworth Filter Design (Lowpass and Highpass) using BLT - Realization of IIR Filters in Direct form I and II.

MODULE - V DESIGN OF FIR FILTERS 8

Design of Linear-phase FIR (low pass and High pass) filters using windows - Rectangular, Bartlett, Hanning, Hamming and Blackman windows - Structure for FIR Systems: Direct form and Cascade form.

MODULE - VI DSP ARCHITECTURE AND FEATURES 7

Introduction - Architecture - Features - Addressing formats - Functional modes - Introduction to commercial DS Processors.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. John G. Proakis , Dimitris G Manolakis, ,'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 5th edition, 2022.

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2. Sanjit. K. Mitra, 'Digital Signal Processing –A Computer Based Approach', McGraw Hill Edu, 4th edition. 2013.

REFERENCE BOOKS:

1. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning, 3rd edition, 2016.
2. Poorna Chandra S, Sasikala. B, Vijay Nicole, "Digital Signal Processing", TMH, 2013.
3. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 3rd Edition, 2017
4. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2nd Edition 2012.
5. Sen M. kuo, woon- seng Gan,"Digital Signal Processors, Architecture, Implementations & Applications, Pearson, 2013

WEB RESOURCES:

1. https://nptel.ac.in/courses/117/102/117102060.
2. https://nptel.ac.in/courses/117/104/117104070.

ONLINE RESOURCES:

1. https://www.udemy.com/course/learn-digital-signal-processing/?srsltid=AfmBOor54io4RnzuABLaak_ok10WPQZbux5A5lqs2Gaq8EXcX14nviy5&couponCode=CM251221G1.

OUTCOMES:

At the end of this course, the students should be able to:

1. Analyze the classifications of signals and systems in the time and frequency domains and evaluate the mathematical representation of signals. (K4)
2. Analyze and apply Z-transform–based techniques to investigate discrete-time signals and systems in the time and frequency domains. (K4)
3. Evaluate and implement FFT-based DIT and DIF algorithms for DFT computation and analyze the properties of the Discrete Fourier Transform. (K4)
4. Develop and implement IIR filters using Direct Form-I and Direct Form-II structures to achieve the desired frequency response. (K5)
5. Develop and evaluate Direct Form and Cascade Form FIR filter structures to achieve the desired frequency response. (K5)

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6. Analyze and evaluate the architecture, features, and performance of Digital Signal Processors for signal processing applications. (K5)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	3	-	-	-	-	-	-	-	1	3	2
CO2	2	3	3	-	-	-	-	-	-	-	1	3	2
CO3	2	2	3	-	-	-	-	-	-	-	1	3	2
CO4	2	2	3	3	-	-	-	-	-	-	1	3	2
CO5	2	2	3	3	-	-	-	-	-	-	1	3	2
CO6	2	3	2	-	-	-	-	-	-	-	1	3	2

DOMAIN GROUP - II: APPLIED ELECTRONICS

COURSE CODE: 24EEEL526	CONSUMER ELECTRONICS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108107715	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11				
PRE-REQUISITE COURSES	24EEPC303					

OBJECTIVES:

- To introduce the fundamentals and scope of consumer electronics
- To understand the principles of audio and sound reproduction systems
- To study the operation of radio and television receivers
- To learn the working of common domestic consumer appliances
- To familiarize students with modern consumer electronic devices
- To provide basic knowledge of servicing and maintenance practices

MODULE – I INTRODUCTION TO CONSUMER ELECTRONICS 7

Definition and scope of consumer electronics – Classification of consumer electronic products – Evolution of consumer electronics – Block diagram and functions of radio receivers, television receivers, and audio/video systems – Consumer electronics versus industrial electronics – Safety precautions in handling consumer electronic equipment.

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MODULE – II AUDIO SYSTEMS AND SOUND REPRODUCTION **8**

Sound and its characteristics – Microphones: carbon, condenser, and dynamic types – Loudspeakers: construction and working of dynamic loudspeaker – Audio amplifiers: pre-amplifiers and power amplifiers – Sound recording and reproduction systems – Tape recorders – Introduction to CD players.

MODULE – III RADIO RECEIVERS **7**

Radio communication system – Amplitude modulation (AM) – Frequency modulation (FM) – Superheterodyne radio receiver – Block diagram and working of AM and FM receivers – Comparison between AM and FM receivers – Common faults and troubleshooting in radio receivers.

MODULE – IV TELEVISION SYSTEMS **8**

Basic principles of television transmission and reception – Black and white television receiver – Block diagram and working – Colour television – Colour theory – PAL colour TV system – TV receiver sections: tuner, IF amplifier, video detector, sound section – Picture tubes and display basics.

MODULE – V DOMESTIC CONSUMER APPLIANCES **7**

Electric iron – Construction and working – Washing machines: semi-automatic and fully automatic – Refrigerators – Vapour compression refrigeration system – Air conditioners: window and split type – Microwave oven – Working principle.

MODULE – VI MODERN CONSUMER ELECTRONICS AND MAINTENANCE **8**

Modern consumer electronic devices: LED/LCD TV, home theatre systems – Power supplies used in consumer electronics – Batteries and chargers – Introduction to servicing and maintenance – Common faults in consumer electronic equipment – Safety standards and energy efficiency.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. S. P. Bali, Consumer Electronics, Pearson Education India, First Edition, 2007, Reprint 2024.
2. R. G. Gupta, Audio and Video Systems, Tata McGraw-Hill Education, 2011.

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REFERENCES

1. Philip Herbert Hoff, Consumer Electronics for Engineers, Cambridge University Press, First Edition, 2005.
2. R. G. Gupta, Consumer Electronics, Tata McGraw-Hill Education, First Edition, 2009.
3. Ronald J. Jurgen, Digital Consumer Electronics Handbook, McGraw-Hill Professional, Second Edition, 2012.

WEB RESOURCES:

1. https://www.youtube.com/watch?v=pkIxCmaxWFg
2. https://www.youtube.com/watch?v=2bprLH4cUSo&t=4s

OUTCOMES:

At the end of this course, the students should be able to:

1. Illustrate and classify consumer electronic systems based on functionality, application, and operating principles. (K3)
2. Interpret and analyze the working of audio systems and sound reproduction devices using appropriate block diagrams and signal flow. (K3)
3. Examine and differentiate the operation of AM and FM radio receivers with reference to circuit blocks and performance characteristics. (K3)
4. Apply fundamental concepts to analyze the operation of black & white and colour television systems. (K3)
5. Analyze the construction and operation of common domestic consumer appliances through functional analysis. (K3)
6. Apply basic troubleshooting, servicing, and maintenance procedures to modern consumer electronic devices in compliance with safety standards. (K3)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	1	2
CO2	2	2	2	-	-	-	-	-	-	-	-	2	2
CO3	3	2	2	-	-	-	-	-	-	-	-	1	2
CO4	2	2	2	-	-	-	-	-	-	-	-	1	2
CO5	2	2	2	-	-	-	-	-	-	-	-	1	2
CO6	3	2	2	-	-	-	-	-	-	-	-	1	2

DOMAIN GROUP - II: APPLIED ELECTRONICS

COURSE CODE: 24EEEL527	ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 11				
PRE-REQUISITE COURSES	24EEPC403					

OBJECTIVES:

- Introduce the fundamentals of electromagnetic interference (EMI) and its sources.
- Explain electromagnetic shielding principles and their practical applications.
- Provide knowledge of interference control and mitigation techniques.
- Develop understanding of grounding methods for safety and signal integrity.
- Familiarize students with EMC standards, measurement techniques, and testing environments.
- Create awareness of EMC issues in wireless, broadband, and modern communication systems.

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MODULE - I INTRODUCTION & SOURCES OF EM INTERFERENCE 7

Introduction - Classification of sources - Natural sources - Man-made sources - Survey of the electromagnetic environment.

MODULE - II EM SHIELDING 7

Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures.

MODULE - III INTERFERENCE CONTROL TECHNIQUES 7

Equipment screening - Cable screening - Power-line filters - Isolation - Balancing - Signal-line filters - Nonlinear protective devices.

MODULE - IV GROUNDING 8

Safety grounds – signal grounds- single point and multipoint ground systems hybrid grounds–grounding of cable shields- -guard shields- isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding

MODULE - V EMC STANDARDS, MEASUREMENTS AND TESTING 8

Need for standards - The international framework - Human exposure limits to EM fields -EMC measurement techniques - Measurement tools - Test environments.

MODULE - VI EMC CONSIDERATIONS IN WIRELESS AND BROADBAND TECHNOLOGIES 8

Efficient use of frequency spectrum - EMC, interoperability and coexistence - Specifications and alliances - Transmission of high-frequency signals over telephone and power networks – EMC and digital subscriber lines - EMC and power line communications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. V.P. Kodali, "Engineering Electromagnetic Compatibility", Second edition – John Wiley & Sons Inc -2001.
2. Henry W.Ott, " Noise reduction techniques in electronic systems", John Wiley & Sons, 1989.
3. Bernhard Keiser, "Principles of Electro-magnetic Compatibility", Artech House, Inc. (685 canton street, Norwood, MA 020062 USA)1987.

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REFERENCES:

1. Bridges, J.E Milleta J. and Ricketts.L.W., "EMP Radiation and Protective techniques", John Wiley and sons, USA1976
2. William Duff G., & Donald White R. J, "Series on Electromagnetic Interference and Compatibility", Vol.
3. Weston David A., "Electromagnetic Compatibility, Principles and Applications",1991.

WEB REFERENCES:

1. https://interferencetechnology.com/electromagnetic-interference-sources-and-their-most-significant-effects/
2. https://en.m.wikipedia.org/wiki/Electromagnetic_interference

OUTCOMES:

At the end of this course, the students should be able to:

1. Identify and classify natural and man-made sources of electromagnetic interference and assess the electromagnetic environment.
2. Explain the principles of electromagnetic shielding and evaluate shielding effectiveness for near-field and far-field sources.
3. Apply interference control techniques such as filtering, isolation, balancing, and protective devices in electronic systems.
4. Analyze grounding concepts and design appropriate grounding schemes for safety, signal integrity, and high-frequency applications.
5. Interpret international EMC standards and perform basic EMC measurements using standard tools and test environments.
6. Evaluate EMC considerations in wireless, broadband, power line, and high-speed communication technologies to ensure coexistence and interoperability.

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	-	-	-	2	1
CO2	3	2	2	-	-	-	-	-	-	-	-	2	2
CO3	3	2	3	-	2	1	-	-	-	-	-	3	2
CO4	3	2	3	-	2	1	1	-	-	-	-	3	2
CO5	2	2	-	3	3	2	1	-	1	-	-	2	1
CO6	3	2	2	1	2	2	-	-	1	-	2	2	1

DOMAIN GROUP - II: APPLIED ELECTRONICS

COURSE CODE: 24EEEP502	PCB DESIGN AND FABRICATION LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: 108102481	SYLLABUS VERSION 1.0	SDG NO. 7, 9				
PRE-REQUISITE COURSES	24BSPH201, 24EEPC201					

OBJECTIVES:

- To introduce the fundamentals of PCB technology and electronic components.
- To develop schematic design and PCB layout skills using industry-standard tools such as KiCad and EasyEDA.
- To provide hands-on exposure to PCB fabrication, assembly, soldering, and testing techniques.
- To understand PCB standards, reliability, safety, and quality control practices.
- To train students in PCB design automation, prototyping, and manufacturing documentation.
- To develop practical skills in PCB testing, troubleshooting, and digital circuit implementation.

MODULE - I PCB FUNDAMENTALS **8**

Introduction to Printed Circuit Boards (PCB) – Advantages of PCB – Components of PCB – Electronic Components – Microprocessors and Microcontrollers – Integrated Circuits (ICs) – Surface Mount Devices (SMD).

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List of experiments:

1. Introduction to KiCad and EasyEDA interface, identification of electronic components and PCB materials
2. Creation of simple schematic diagrams using KiCad.

MODULE - II CLASSIFICATION AND STANDARDS OF PCB 8

Classification of PCBs: Single-layer, Double-layer, Multilayer, Flexible PCBs – PCB Manufacturing Overview – PCB Standards and Specifications (IPC, IEEE, MIL) – Reliability and Safety Considerations.

List of experiments:

1. Create schematic and PCB layout for LED driver circuit using KiCad,
2. Design RC Low Pass filter PCB and RC High Pass filter PCB.

MODULE - III SCHEMATIC DESIGN AND LIBRARIES 7

Schematic Diagram Preparation – Netlist Generation – Creating and Managing Component Libraries – Footprints and Packages – Adding and Editing Pins – Symbols and Annotations.

List of experiments:

1. Design and fabricate a PCB for Regulated power supply with filter and regulation sections.

MODULE - IV PCB LAYOUT DESIGN PRINCIPLES 7

General Design Considerations – Mechanical Design Considerations – Electrical Design Considerations – Component Placement and Mounting – Conductor Spacing – Routing Guidelines –Tracks, Pads, Vias – Power Planes – Grounding Techniques – Heat Management and Package Density.

List of experiments:

1. Create and verify component library and footprint, perform routing, DRC and ERC verification.

MODULE - V PCB MANUFACTURING AND ASSEMBLY PROCESSES 7

Copper-Clad Laminates: Materials, Electrical and Physical Properties – Types of Laminates – Film Master Preparation – Image Transfer – Photoprinting – Screen Printing – Drilling and Plating Techniques – Etching Techniques – Mechanical Machining Operations – Lead Cutting – Soldering Techniques.

List of experiments:

Generate Gerber and drill files for manufacturing, design and fabricate Half Adder / Full Adder PCB.

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MODULE - VI PCB AUTOMATION, TESTING AND EMERGING TRENDS 8

Design Automation – Auto Routing – Design Rule Checking (DRC) – Exporting Gerber and Drill Files – PCB Prototyping Machines – Testing and Quality Control – Post-Design Verification –Recent Trends in PCB Technology – Environmental Concerns and Green PCB Manufacturing.

List of experiments:

1. Design NAND-based logic implementation PCB
2. IoT Sensor Interface PCB

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Printed Circuit Board – Design & Technology, Walter C. Bosshart, Tata McGraw Hill, 2008.
2. Printed Circuit Board –Design, Fabrication, Assembly & Testing, R.S. Khandpur, First Edition, Tata Mcgraw-Hill Education Pvt. Ltd., 2005.

REFERENCE BOOKS:

1. Printed Circuit Board Design Using Autocad, Chris Schroeder, Newnes Publisher, 1998.
2. Printed Circuits Handbook, Clyde F. Coombs, Jr, Happy T. Holden, Sixth Edition, Publisher: McGraw-Hill Education, 2016.

WEB RESOURCES:

1. PCB Design Tutorials – Altium https://www.altium.com/solutions/pcb-design
2. KiCad Official Documentation https://docs.kicad.org
3. EasyEDA Learning Center https://easyeda.com/learn
4. PCB Design Guidelines – IPC Standards Overview https://www.ipc.org/standards
5. Printed Circuit Board Design Basics – All About Circuits https://www.allaboutcircuits.com/technical-articles/

ONLINE RESOURCES:

1. PCB Manufacturing Process – Sierra Circuits - https://www.protoexpress.com/blog/
2. EDA Tool Tutorials – Cadence (OrCAD / Allegro) - https://www.cadence.com/en_US/home/training.html
3. PCB Assembly and Soldering Techniques – Electronics Tutorials - https://www.electronics-tutorials.ws

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4. IPC Training and Certification Programs - https://education.ipc.org
5. Recent Trends and Green PCB Manufacturing - https://www.eetimes.com
6. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee187

PCB Design Softwares recommended

1. KiCAD (Open Source Electronics Design Automation Suite) https://www.kicad.org/
2. EasyEDA (Online PCB Design Tool) https://easyeda.com/
3. PADS - Siemens EDA (PCB Design Software) https://eda.sw.siemens.com/en-US/pcb/pads/

OUTCOMES:

At the end of this course, the students should be able to:

1. Apply the fundamentals of PCB technology, electronic components, and PCB standards in circuit design. (K3)
2. Develop schematic diagrams and PCB layouts using KiCad and EasyEDA tools. (K3)
3. Apply PCB layout principles including routing, grounding, thermal management, and component placement techniques. (K3)
4. Perform PCB fabrication, assembly, drilling, soldering, and inspection processes using standard procedures. (K3)
5. Generate Gerber and drill files, perform DRC/ERC verification, and prepare PCB manufacturing documentation. (K3)
6. Test, troubleshoot, and validate fabricated analog and digital PCBs for reliable operation. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	1	–	–	–	–	–	–	2	1
CO2	2	3	3	1	3	–	–	–	1	1	1	3	2
CO3	2	3	3	1	2	–	–	–	–	–	–	3	2
CO4	2	2	2	2	2	1	–	–	1	1	1	3	2
CO5	2	3	3	2	3	–	–	–	–	–	1	3	3
CO6	2	3	2	3	2	–	–	–	1	1	–	3	3

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