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 MECHANICAL & AUTOMATION 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 MECHANICAL & AUTOMATION ENGINEERING

VISION

To develop a daedal mechanical and automation department to cater the ever evolving needs of automation of core engineering based on fundamental and extensive research.

MISSION

M1 – Prepare the mechanical and automation engineering graduates, for a successful career in engineering and technology through effective teaching-learning.
M2 – Amalgamate core engineering branches with recent trends of automation in vogue for a successful career in the dynamic industrial scenario.
M3 – Promote excellence in engineering and technology by motivating the students for higher studies.
M4 – Empower the learners by importing education that is compatible with the technological needs of the industry and thereby ensuring to contribute to the society.
M5 – Accentuate professionally competent engineers by developing analytical and research abilities, encouraging the culture of continuous learning by adopting new technologies.

Curriculum / MU

AUTONOMOUS CURRICULA AND SYLLABI
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SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	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					
		As recommended by BoS					
					Total	30	25

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
		THEORY					
1	24BSMA203	Differential Equations and its Applications	3	1	0	4	4
2	24HSEN201	Professional English	2	0	0	2	2
3	24BSPH202	Physics of Materials	3	0	0	3	3
4	24BSCY201	Chemistry for Environment and Sustainability	3	0	0	3	3
5	24ESCE201	Engineering Mechanics	3	0	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	24ESID201	Idea Engineering Lab - II	0	0	2	2	1
2	24ENTP201	Digital Dynamics	0	0	2	2	0
		ONLINE SUPPLEMENTARY					
1	24ESMC201	MS Office (Mandatory - NC)	0	0	0	0	0
					Total	24*	19

*only for NCC cadets, to be conducted beyond working hours

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SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24BSMA304	Transforms and Numerical Methods	3	1	0	4	4
2	24MUPW301	Basic Manufacturing Processes with Laboratory	3	0	2	5	4
3	24ESEI302	Basic Electronics and Control System	3	0	0	3	3
4	24MUPC301	Thermodynamics and Fluid Mechanics	3	0	0	3	3
5	24MUPW302	Sensor in Automation with Laboratory	3	0	2	5	4
6	24HSMC301	Universal Human Values - II	3	0	0	3	3
7	24HSNC301	NCC course Level 2*	3*	0	0	3*	0
		PRACTICALS					
1	24MUPL301	Computer Aided Drafting Laboratory	0	0	4	4	2
		VALUE ADDITIONS - III					
1	24MUTP301	Aptitude skills - I	0	0	2	2	1
2	24MUID301	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	33	25

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24MUPC401	Fluid Power Automation	3	0	0	3	3
2	24MUPC402	Theory of Machines	3	0	0	3	3
3	24MUPC403	Robots and Systems in Smart Manufacturing	3	0	0	3	3
4	24MUPW401	CNC and Metrology with Laboratory	3	0	2	5	4
5	24CEPC405	Strength of Materials	3	0	0	0	3
6	24MGOExxx	Open Elective - 1**	3	0	0	3	3
7	24HSNC401	NCC course Level 3*	3	0	0	3*	0
		PRACTICALS					
1	24MUPL401	SoM and Fluid power systems Laboratory	0	0	4	4	2
2	24MUPT401	Additive Manufacturing Laboratory with Theory	1	0	4	5	3
		VALUE ADDITIONS - IV					
1	24MUTP401	Aptitude skills - II	0	0	2	2	0
2	24MUID401	Innovative Design Lab - II	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
		As recommended by BoS					
					Total	33	25

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SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CP	C	PREREQUISITE COURSES
		THEORY						
1	24MUPC501	Machine Design	3	0	0	3	3	24ESCE201, 24CEPC405
2	24EEPW501	Electrical Drives and Actuators with Laboratory	3	0	2	5	4	-
3	24MUEL5xx	Professional Elective - I	3	0	0	3	3	-
4	24MUEL5yy	Professional Elective - II	3	0	0	3	3	-
5	24xxOExxx	Open Elective #	3	0	0	3	3	-
6	24MGMC501	Constitution of India	2	0	0	2	0	-
		PRACTICALS						
1	24MUPL501	Design and Simulation Laboratory	0	0	4	4	2	24MUPC301
		VALUE ADDITIONS						
1	24MUPT501	Skill Enhancement	0	0	2	2	1	-
2	24MUID501	Prototype Development Lab - I	0	0	2	2	1	-
		ONLINE SUPPLEMENTARY						
		As recommended by BoS						-
		Total				27	20	

Cyber Security UGC

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24MUPC601	Mechanics and Control of Robotic Manipulators	3	0	0	3	3
2	24MUEL6xx	Professional Elective - III	3	0	0	3	3
3	24MUEL6yy	Professional Elective - IV	3	0	0	3	3
4	24MUEL6zz	Professional Elective - V	3	0	0	3	3
5	24HSMG501	Principles of Engineering Management	3	0	0	3	3
6	24xxOExxx	Open Elective - III	3	0	0	3	3
		PRACTICALS					
1	24MUPL601	Robotics Laboratory	0	0	4	4	2
		VALUE ADDITIONS - VI					
1	24MUTP601	Technical Skill	0	0	2	2	0
2	24MUID601	Prototype Development Lab - II	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
		As recommended by BoS					
		Total				26	21

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SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24MUPC701	Mechatronics System Design	3	0	0	3	3
2	24ESEI701	PLC and Microcontroller	3	0	0	3	3
3	24MUEL7xx	Professional Elective - VI	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	24MUPL701	Automation Lab	0	0	4	4	2
2	24MUPJ701	Project work - Phase I	0	0	8	8	4
VALUE ADDITIONS - VII							
1	24MUTP701	Company Specific Skills	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BoS					
				Total		28	21

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24MUEL8xx	Professional Elective – VII	3	0	0	3	3
PRACTICALS							
1	24MUPJ801	Project Work - Phase II	0	0	12	12	6
VALUE ADDITIONS - VIII							
1	24MUIN801	Internship	0	0	9	9	3
				Total		21	12

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PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24MUEL501	Industrial Automation for Manufacturing	3	Robotics and Automation	24MUPW301
2	24MUEL502	Artificial Intelligence for Robotics	3	Robotics and Automation	24MUPC403
3	24MUEL503	Automation Principles	3	Robotics and Automation	24MUPW302
4	24MUEL504	Automobile Engineering	3	Intelligent Mobility System	-
5	24MUEL505	Automotive Materials and Manufacturing	3	Intelligent Mobility System	24BSPH202
6	24MUEL506	Smart Mobility and Intelligence Vehicles	3	Intelligent Mobility System	24MUPW302
7	24MEEL504	Non Destructive Testing and Evaluation	3	Materials and Manufacturing	-
8	24MEEL505	Rapid Manufacturing	3	Materials and Manufacturing	-
9	24MEEL506	CNC Machine Tools and Programming	3	Materials and Manufacturing	-
10	24EEEL512	Micro Electro Mechanical Systems	3	Applied Electronics	24BSPH101, 24BSPH202
11	24EEEL513	Green Electronics	3	Applied Electronics	-
12	24EEEL502	PCB Design and Fabrication Laboratory with Theory	3	Applied Electronics	-
13	24MEIExxx	Industry Connected Course	3		-

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24MUEL507	Robot Operation System	3	Robotics and Automation	24MUPC403
2	24MUEL508	Industrial Robot Theory and Implementation	3	Robotics and Automation	24MUPC403
3	24MUEL509	Automation in Process Industries	3	Robotics and Automation	24MUPW401
4	24MUEL510	Electric and Hybrid Vehicles	3	Intelligent Mobility System	-
5	24MUEL511	Energy Storage and Electric Mobility Systems	3	Intelligent Mobility System	-
6	24MUEL512	Electric Vehicle Ecosystem	3	Intelligent Mobility System	-
7	24MEEL516	Material Joining Techniques	3	Materials and Manufacturing	-
8	24MEEL517	Casting and Welding Processes	3	Materials and Manufacturing	-
9	24MEEL518	Testing of Materials	3	Materials and Manufacturing	24MUPL401
10	24EEEL525	Consumer Electronics	3	Applied Electronics	-
11	24EEEL526	Digital Signal Processing	3	Applied Electronics	-
12	24EEEL527	Electromagnetic Interference and Electromagnetic Compatibility	3	Applied Electronics	-

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INDUSTRY CONNECTED PROFESSIONAL ELECTIVES
Delphi TVS

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24MEIE501	Advanced Fuel Injection System - I	3	Energy Engineering
2	24MEIE601	Advanced Fuel Injection System - II	3	Energy Engineering

INDUSTRY CONNECTED PROFESSIONAL ELECTIVES
L&T

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24MEIE502	Design of Fire and Life Safety Systems	3	Building Utility Service
2	24MEIE503	Building Information Modelling in Construction	3	Inter-disciplinary
3	24MEIE504	Safety for Engineers	3	Inter-disciplinary
4	24MEIE505	Utility Systems for Industrial Facilities	3	Process Plant Engineering
5	24MEIE506	Ambience Control System Design	3	Building Utility Service
6	24MEIE507	Mechanical Service Engineering	3	Building Utility Service
7	24MEIE508	Engineering Strategies for Sustainability	3	Inter-disciplinary
8	24MEIE509	Power Plant Engineering - An Industrial Context	3	Power Plant Engineering
9	24MEIE601	Industrial Piping & Pipeline Engineering	3	Mechanical & Chemical Engineering
10	24MEIE602	Integrated Approach to Building Services	3	Building Utility Service
11	24MEIE603	Industrial Valves – Application, Manufacturing & Special Testing	3	Manufacturing Engineering
12	24MEIE604	Heavy Manufacturing and Elements of digitalization	3	Digital Manufacturing
13	24MEIE605	Robotics and Digitalization in Manufacturing	3	Digital Manufacturing
14	24MEIE606	Digital Technologies with CPS, IIOT & Cloud in Manufacturing	3	Digital Manufacturing
15	24MEIE607	Design & Simulation of Process Plant Equipment	3	Process Plant Engineering
16	24MEIE608	Technology and Processes in Heavy Manufacturing	3	Manufacturing Engineering
17	24MEIE609	Heat Exchanger: Design & Applications	3	Process Plant Engineering
18	24MEIE701	Collaborative Robotics in Manufacturing with AI, ML & IIOT	3	Digital Manufacturing
19	24MEIE702	Steam Generator & Auxiliary Systems	3	Power Plant Engineering
20	24MEIE703	Steam Turbine & Auxiliary Systems	3	Power Plant Engineering
21	24MEIE704	Project Management for Professionals	3	Inter-disciplinary

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Graduates will have sound technical acumen and leadership to become competent engineers leading to a successful career.

PEO 2: Graduates will pursue lifelong learning in generating innovative engineering solutions using fundamentals in basic science and complex problem-solving skills.

PEO 3: Graduates will strengthen entrepreneurial quality and self-employment in the program adopted..

PEO 4: Graduates will inculcate ethical responsibilities and render service towards peers, society and the nation without compromise.

PEO 5: Graduates will demonstrate commitment towards sustainable development for the betterment of the society ensuring ethical and moral values.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Capable of exhibiting the knowledge and skills in understanding the basic concepts of the Mechanical and Automation Engineering and improving the performance of manufacturing and production systems by implementing the latest technological advancements and excel as entrepreneurs.

PSO 2: Posses sound fundamentals of basic sciences so as to apply them for engineering problem analysis and research in multiple related spheres, showing passion for higher education and research in the chosen field.

COMPONENTS OF THE CURRICULUM (COC)

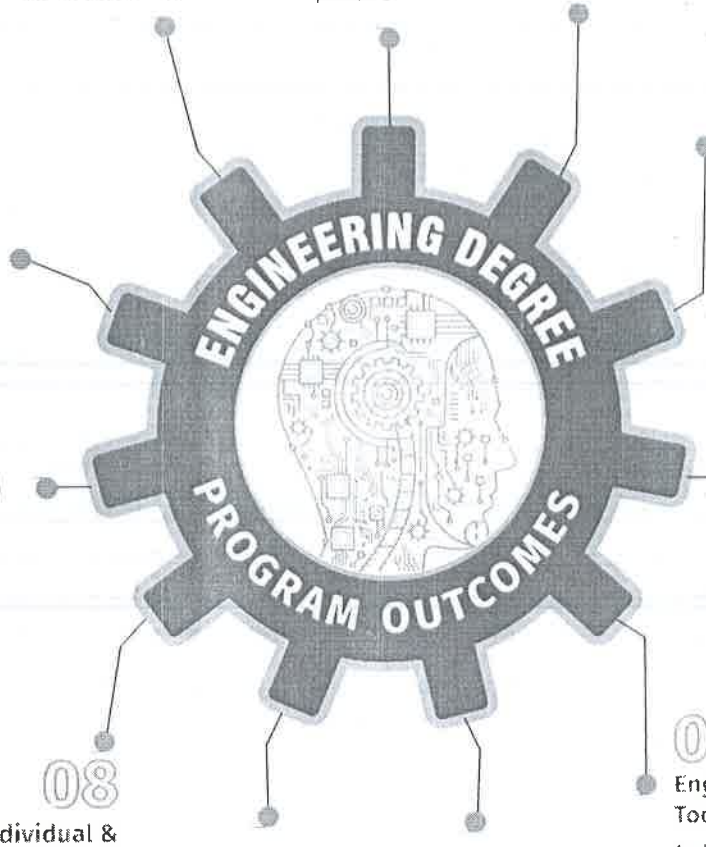
Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total Number of credits
Basic Sciences (BS)	15	28	26
Engineering Sciences (ES)	9	18	15
Humanities and Social Sciences (HS)	8	13	13
Professional Electives (EL)	14	23	23
Program Core + Program Lab (PC+PL)	27	57	45
Program theory with Lab (PW) / Program Lab With Theory (PT)	7	15	11
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)	0	4	0
Total	100	225	168

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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



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

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

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.

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

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

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

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

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

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

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

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SEMESTER - I

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

OBJECTIVES:

- To understand and gain the knowledge of matrix algebra.
- To introduce the concepts of limits, continuity, derivatives, maxima and minima for functions of several variables.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To provide understanding of double integration, triple integration and their applications.
- To impart the knowledge of Fourier series..

MODULE - I MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem (without 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. Problems involving 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 - Change of variables from cartesian to Spherical and Cylindrical polar coordinates.

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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://math.mit.edu/~gs/linearalgebra/ila0601.pdf
2. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter30/
3. https://ocw.mit.edu/courses/mathematics/18-02sc-multivariable-calculus-fall-2010/2.-partial derivatives/
4. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter31/

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra/alternate-bases/eigen-everything/v/linear algebra-introduction-to-eigenvalues-and-eigenvectors
2. https://www.khanacademy.org/math/differential-calculus

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)

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Department of Humanities & Sciences

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

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

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

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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

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

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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)

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 31/05/2024

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

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, CO2 laser – Basic applications of lasers in industry.

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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.

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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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Meeting No. 6 Dated: 31/05/2024

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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	4	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.

Recommended by Board of Studies of H&S dept. Meeting No. 6 Dated: 31/08/2024

Recommended by S. Narayanakumar Board Department of Humanities & Sciences

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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Chairman Board of Studies Department of Humanities & Sciences

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 & Company LTD, 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.
8. Chemical and Electrochemical Energy Systems, R. Narayanan, B. Viswanathan, University Press India Limited.

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)

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2. Recognize the basic principles of electrochemistry and describe their application in battery technologies. (K3)
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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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 in Sequential Access File - Random Access File - Example Program:

Recommended by
Board of Studies of CSE dept.
Meeting No. 7 Dated: 30/5/19

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

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

Recommended by
Board of Studies of CSE dept.
Meeting No. 7 Dated: 30/5/24

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Board of Studies
Department of Computer Science and Engineering
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 MCCH dept.
Meeting No. 8 Dated: 1/6/24

CHAIR
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 dept.
Meeting No. 8 Dated: 1/6/24

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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

Recommended by
Board of Studies of MECH dept.
Meeting No. 8 Dated: 1/6/19

Board of Studies
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

UNIT - I LANGUAGE AND LITERATURE 3

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

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

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

UNIT - III FOLK AND MARTIAL ARTS 3

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

UNIT - IV THINAI CONCEPT OF TAMILS 3

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

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

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

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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.

தமிழர் மரபு

அலகு - I மொழி மற்றும் இலக்கியம்: 3

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

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

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

அலகு - III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

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

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அலகு - IV தமிழர்களின் திறைக் கோட்பாடுகள்: 3

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

அலகு - V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்ப்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

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OUTCOMES:

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

1. Understand Tamil as a classical language & Literature (K2)
2. Explore about Tamil Heritage & Sculptures,Role of temples (K2)
3. Appreciate Sports and games of Tamils (K2)
4. Perceive Thinai concept of Tamils (K2)
5. Comprehend Education and literacy during Sangam Age (K2)
6. Understand the Contribution of Tamils to National Movement & Indian Culture (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	-	-	-	-	-	3	-	-	-	-	3	-	-
CO6	-	-	-	-	-	3	-	-	-	-	3	-	-

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.

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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).

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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, ParikshitGogoi, 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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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 C LABORATORY	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. 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.
13. Write a program to solve towers of Hanoi using recursion.

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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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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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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)

MODULE - 2 Universal SDG Targets **4**

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

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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.

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

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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

24BSMA203 - SDG NO. 4	DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- To solve second and higher order differential equations with constant and variable coefficients.
- To find the numerical solution of ordinary and partial differential equations.
- To solve first order partial differential equations, linear homogeneous and non homogeneous partial differential equations of second and higher order.
- To find the Fourier series solution for one dimensional wave equation, one and two dimensional heat equations.
- To obtain the numerical solution of partial differential equations.

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 types - System of simultaneous linear differential equations with constant coefficients.

MODULE - II NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 10

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

MODULE - III SOLUTIONS OF FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS 9

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

MODULE - IV SOLUTIONS OF LINEAR PARTIAL DIFFERENTIAL EQUATIONS 9

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

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MODULE - V APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS10

Classification of Partial Differential Equations – Method of separation of variables – Fourier Series Solutions of one-dimensional wave equation – Transient state solution of one dimensional heat conduction equation – Steady state solution of two dimensional heat conduction equation.

MODULE - VI NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 10

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. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Advanced Modern Engineering Mathematics, Glyn James, 3rd Edition, Pearson Education, 2010.
3. Numerical Methods for Scientific and Engineering Computation, M. K. Jain, S. R. K. Iyengar, R. K. Jain, 4th Edition, New age international Private Ltd. 2003.

REFERENCES:

1. Numerical methods, Kandasamy P, Thilagavathy, Dr. K. Gunavathy, 1st Edition, S. Chand & Company Ltd.. 2006.
2. Higher Engineering Mathematics, B.S. Grewal, 44th Edition, Khanna Publishers, 2010.
3. Applied Numerical Analysis, Gerald, C.F. and Wheatley, P. O., 7th Edition, Pearson Education, Asia, New Delhi, 2004.
4. Transforms and Partial Differential Equations, 3rd Edition Veerarajan T, McGraw Hill Education (India) Private Limited, 2016.

WEB REFERENCES

1. https://people.maths.ox.ac.uk/suli/nsodes.pdf
2. https://skim.math.msstate.edu/LectureNotes/NumerPDEs_Lecture.pdf
3. https://math.libretexts.org/Bookshelves/Differential_Equations/Differential_Equations_for_Engineers_(Lebl)/4%3A_Fourier_series_and_PDEs/4.07%3A_One_dimensional_wave_equation
4. https://ocw.mit.edu/courses/18-303-linear-partial-differential-equations-fall-2006/d11b374a85c3fde55ec971fe587f8a50_heateqni.pdf

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ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=NBcGLLU90fM&list=PLbMVogVj5nJSGlf9sluucwobyr_zz6gl
2. https://www.youtube.com/watch?v=B9l1fZLLW1E
3. https://www.youtube.com/watch?v=7JrMHsiSNWA&list=PLpklqhIbn1jq0ngwe94LpiZ8OG8eiNzC-
4. https://in.video.search.yahoo.com/search/video?fr=mcafee&ei=UTF-8&p=solution+of+one+dimensional +HEAT+equation+VIDEO&vm=r&type=E211IN714G0#id=2&vid=8e1235b2280eb002b6055c30955520cd&action=view

COURSE OUTCOMES:

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

1. Solve ordinary differential equations of second and higher order differential equations with constant and variable coefficients. (K3)
2. Apply various differential equation techniques to solve ordinary differential equations. (K3)
3. Determine the solution of first order partial differential equations. (K3)
4. Apply the concepts of partial differential equations in heat and wave equations. (K3)
5. Solve partial differential equations of second and higher order differential equations with constant coefficients. (K3)
6. Apply various partial differential equation techniques to solve partial differential equations. (K3)

CO-PO, PSO MAPPING:

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

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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
- 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

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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

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_

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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)
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	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO6	-	-	-	-	-	-	-	-	-	3	-	3	-	-

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SEMESTER - II

24BSPH202 - SDG NO.4	PHYSICS OF MATERIALS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To introduce the formation of alloy and phase diagrams.
- To interpret the properties of ferrous alloys and their uses.
- To familiarize with the magnetic properties of materials.
- To expose the dielectric and superconducting materials properties and application.
- To explicate the properties and applications of new engineering materials.
- To inculcate the idea of significance of nanostructures, properties and applications.

MODULE - I ALLOY FORMATION AND PHASE DIAGRAMS **8**

Introduction to alloys - Solid solutions - Hume Ruthery's rule - types of alloying elements and their effects - Gibbs free energy and its application to alloy formation - Driving forces for alloy formation: enthalpy and entropy (Qualitative) - Definition and types of phase diagrams - Components, phases, and phase equilibrium - Construction and interpretation of binary phase diagrams: Isomorphous, Eutectic and Peritectic systems - Tie-line, Lever rule and its application in determining phase fractions.

MODULE - II FERROUS ALLOYS **7**

Ferrous alloys: types, - Iron-carbon Diagram – Phases and phase transformation - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels – factors influencing microstructure formation in ferrous alloys - effect of alloying elements on the iron-carbon system - T-T-T-diagram for eutectoid steel - pearlite, baintic and martensite transformations - tempering of martensite - Mechanical properties of ferrous alloys –hardness –Brinell and Vickers – fatigue.

MODULE - III MAGNETIC PROPERTIES OF MATERIALS **8**

Magnetic dipole moments - atomic magnetic moments - magnetic permeability and susceptibility - Magnetic material classification: diamagnetism - paramagnetism - ferromagnetism - antiferromagnetism - Ferromagnetism: origin and exchange interaction - Domain Theory - M versus H behaviour - Hard and soft magnetic materials - applications – Ferrites and its applications.

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MODULE - IV DIELECTRIC AND SUPERCONDUCTING MATERIALS **7**

Dielectric materials - types of polarization - Langevin-Debye equation - frequency and temperature effects on polarization - dielectric breakdown - Ferroelectric materials - superconducting materials - properties - Type-I and Type-II superconductors - applications - Cryotron, SQUID and Magnetic Levitation.

MODULE - V NEW ENGINEERING MATERIALS **8**

Metallic glasses: types, glass forming ability of alloys, twin spinning process, and applications - shape memory alloys: phases shape memory effects, pseudo elastic - NiTi alloy, applications - Ceramics – mechanical, thermal, electrical, magnetic, optical properties and its applications, Composites: Classification, role of matrix and reinforcement- mechanical, thermal, electrical properties and its applications - Biomaterials and its application.

MODULE - VI NANO MATERIALS **7**

Introduction to Nanomaterials - Quantum Confinement and Size Effects - Quantum well, Quantum wire and Quantum dot - Synthesis methods for nanomaterials - top down - Ball Milling Method - bottom up – CVD - Electronic, mechanical, thermal, magnetic properties - Nanomaterials in Electronics and Photonics- solar cells, QD LED - Biomedical applications of Nanomaterials - biosensors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. William D. Callister Jr., William D. Callister Jr., David G. Rethwisch, "Callister's Materials Science and Engineering", 10th edition, Global edition, John Wiley & Sons, 2019.
2. V.Raghavan, "Physical Metallurgy: Principles and Practice", PHI Learning, 2015.
3. S.O. Pillai "Solid State Physics", New Age International Publishers, 5th Edition, New Delhi, 2018.
4. C. Kittel, "Introduction to Solid State Physics", Wiley, 2019.
5. Palanisamy P.K. Materials Science. SCITECH publishers, 2015.

REFERENCES:

1. O.P.Kanna, "Materials science and Metallurgy", Dhanpat Raj Publications, 2nd edition, 2014.
2. Susan Troiler –Mckinstry and Robert E. Newnham, "Materials Engineering: Bonding, Structure, Structure – property relationship" Cambridge University Press, 2018.

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3. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.
4. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 2014 (ebook).
5. Nanomaterials – Handbook by Yury Gogotsi, CRC Press, Taylor & Francis group, 2006.

OUTCOMES:

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

1. Illustrate the concept of alloy formation, phase rule, application of Tie-line and Lever rule to determine the phase percentage in binary system (K3)
2. Infer the various phases, invariant phase reactions of the Iron-Carbon phase diagram, different microstructures and the impact of alloying elements in ferrous alloys (K3)
3. Recall the basics of different types of magnetic materials with understanding atomic interactions and magnetic domain physics and their practical uses (K3)
4. Elucidate the basic knowledge of dielectric and superconducting materials and their respective utilizations (K3)
5. Have an insight on new engineering materials such as metallic glasses, shape memory alloys, ceramics, composites, biomaterials and their applications (K3)
6. Recognize the fundamental concepts of nanomaterial, preparation methods, properties and its significant applications. (K3)

CO-PO MAPPING:

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

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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 (CO_2, CH_4, N_2O, 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 H2O2 as benign bleaching agents in the paper industry.

Sustainable Development: Definition and concepts of sustainable

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development, Need for sustainable development; Sustainable development 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

24ESCE201 SDG NO. 4, 9, 12	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the use scalar and vector analytical techniques for analysing forces.
- To introduce the equilibrium of rigid bodies, vector methods and free body diagram
- To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems
- To develop basic dynamics concepts – force, momentum, work and energy.
- To predict the effect of force and motion in the course of carrying out the design functions of Engineering

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MODULE - I STATICS OF PARTICLES 7

Introduction – Units and Dimensions – Laws of Mechanics –Newton's laws-Lami's theorem- Parallelogram, triangular Law and polygon law of forces-Principle of transmissibility-Vectorial representation of forces – Fundamental vector operations of forces–Free body diagram- Equilibrium of a particle in 2 D – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces.

MODULE - II EQUILIBRIUM OF RIGID BODIES 9

Beams and Trusses - Moments and Couples - Vectorial representation– Scalar components of a moment – Varignon's theorem- Moment of a force about a point and about an axis- Single equivalent force-Types of supports –Action and reaction forces – types of equilibrium -Equilibrium of Rigid bodies in Two and Three dimensions.

MODULE - III FRICTION 7

Friction force – Types of friction-Laws of Coulomb friction – Simple contact friction-Two bodies in contact- Wedge friction, ladder friction- Rolling resistance.

MODULE - IV PROPERTIES OF SURFACES AND SOLIDS 8

Centroids and Centre of Mass and Volume – Simple and Composite areas and solids -Theorems of pappus - Moments of Inertia of composite areas – Parallel axis theorem and perpendicular axis theorem –Polar moment of inertia-Radius of gyration-Product of inertia-Principal moments of inertia of plane areas and composite areas – Principal axes of inertia-Mass moment of inertia –Prismatic, Cylindrical and spherical solids from first principle.

MODULE - V DYNAMICS-KINEMATICS 7

Displacement, Velocity and Acceleration – Relative motion - Curvilinear motion - Newton's laws of motion.

MODULE - VI DYNAMICS-KINETICS 7

D' Alembert's principle, Work Energy principle - Impulse and Momentum – Impact of elastic bodies. Rigid body motion-Translation and Rotation– General Plane motion of simple rigid bodies such as Cylinder, Disc or Wheel and Sphere.

TOTAL: 45 PERIODS

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Civil Engineering

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing Company, New Delhi, 2004.
2. N.H Dubey, "Engineering Mechanics – Statics and Dynamics", McGraw Hill Education (India) Pvt Ltd.
3. Vela Murali, "Engineering Mechanics", Oxford University Press, 2010.

REFERENCES:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna MohanaRao. G., "Engineering Mechanics Statics and Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
6. Dr.N.Kottiswaran, Engineering Mechanics (statics and Dynamics), Sri Balaji Publications, Erode.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/105/112105164/
2. https://nptel.ac.in/courses/112/103/112103109/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/106/112106286/
2. https://nptel.ac.in/courses/112/103/112103108/
3. https://nptel.ac.in/courses/112/106/112106180/
4. https://www.coursera.org/learn/engineering-mechanics-statics

OUTCOMES:

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

1. Interpret the concepts of laws of mechanics, vector operations, systems of Forces and equilibrium of particles in spaces. (K3)
2. Solve the engineering problems based on the concepts moment and couples, support and its types and equilibrium of rigid bodies in 3 dimensions. (K3)

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3. Illustrate about Friction, its types, laws of friction, wedge and ladder friction. (K2)
4. Apply the concepts of centroid, centre of gravity, polar moment of inertia and principal moment of inertia for prisms, cylinder and spherical solids. (K3)
5. Solve engineering problems based on the concepts of relative motion and curvilinear motion. (K3)
6. Apply the concepts of Newton's law of motion, work energy method, impulse and momentum and rigid body motion in engineering problems. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	1	1	-	-	-	-	2
CO2	3	3	1	1	-	1	1	-	-	-	-	2
CO3	3	3	1	1	-	2	1	-	-	-	-	2
CO4	3	3	1	1	-	1	1	-	-	-	-	2
CO5	3	3	1	1	-	1	1	-	-	-	-	2
CO6	3	3	1	1	-	1	1	-	-	-	-	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

UNIT - I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT - II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

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UNIT - III MANUFACTURING TECHNOLOGY 3

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

UNIT - IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

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

UNIT - V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

Recommended by
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Meeting No. 6 Dated: 31/05/2024

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தமிழர் மரபு

அலகு - I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

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

அலகு - II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

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

அலகு - III உற்பத்தித் தொழில் நுட்பம்: 3

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

அலகு - IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3

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

அலகு - V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: 3

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

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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. Understand Weaving and Ceramic Technology during Sangam Age (K2)
2. Explore about Design & Construction of House and Temples during Sangam Age (K2)
3. Appreciate Manufacturing Technology of Tamils (K2)
4. Perceive Agriculture and Agro-processing during Sangam Age (K2)
5. Comprehend Ancient Knowledge of Ocean & Fisheries(K2)
6. Understand the Scientific Tamil & Tamil Computing (K2)

CO- PO, PSO MAPPING

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

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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

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

Recommended by
Board of Studies of H&S dept.
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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
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

Recommended by Board of Studies of H&S dept. Meeting No. 6 Dated: 31/oct/2019

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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
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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Board of Studies of MECH dept.
Meeting No. 8 Dated: 1/6/24

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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.

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Meeting No. 8 Dated: 1/6/19

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MECHANICAL ENGINEERING PRACTICE

Welding:

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

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

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CIVIL

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

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Mechanical Engineering

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)

CO-PO, PSO MAPPING:

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

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

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

MODULE-6 SCOUT for SDG IDEATHON 12

Evaluation Stages:

- First Round

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Board of Studies of HAS dept.
Meeting No. 6 Dated: 31/05/2024

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Department of Humanities & Sciences

- 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

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

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 21/6/2024

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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 principles 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	-	-

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SEMESTER - III

24BSMA304 - SDG NO. 4	TRANSFORMS AND NUMERICAL METHODS	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- Determine Laplace transform for various functions and basic properties
- Solving differential equations using Laplace transforms
- 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 discipline
- To introduce basic concepts of python for using the software to find the numerical solution.

MODULE - I 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 and integrals – Transform of Periodic functions.

MODULE - II INVERSE LAPLACE TRANSFORMS **9**

Partial fraction method – using properties - Convolution theorem - Initial and Final value theorem - Solution of second order linear ordinary differential equations with constant coefficients.

MODULE - III NUMERICAL SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS **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.

MODULE - IV INTERPOLATION **9**

Newton's forward and backward difference interpolation - Lagrange's and Newton's divided difference interpolations.

Studies dept. No. 6 Dated: 31/08/2024

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MODULE - V NUMERICAL DIFFERENTIATION AND INTEGRATION 9

Approximation of derivatives using interpolation polynomials – Solution of single integrations using Trapezoidal, Romberg method, Simpson's 1/3 & 3/8 rules - Solution of Double integration using Trapezoidal, Simpson's 1/3 rules.

MODULE - VI PYTHON AND ITS NUMERICAL IMPLEMENTATION 9

Variables, Data types, Input/Output – Control structures: if, for, while - Functions and basic error handling - Introduction to Jupyter Notebook / Google Colab or any IDE – Python libraries for numerical computing – NumPy, SciPy, matplotlib, SymPy – Solving an algebraic / transcendental equation (scipy.optimize.bisect, scipy.optimize.newton) – Interpolating temperature data from a dataset (scipy.interpolate.lagrange, interp1d) - Differentiating a dataset to find velocity from displacement (numpy.gradient) - Integrating a function to find area under curve (scipy.integrate.trapz, scipy.integrate. simps).

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Numerical Analysis, Burden, R.L and Faires, J.D, 9th Edition, Cengage Learning, 2016.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 9th edition, John Wiley & Sons, 2006.
3. Higher Engineering Mathematics, Ramana B.V, Tata McGraw Hill Publishing Company, New Delhi, 2017.

REFERENCES:

1. Higher Engineering Mathematics, Dass H. K. and Er. Rajnish Verma, 3rd Edition, S. Chand, 2014.
2. Numerical Methods in Engineering and Science, Grewal B. S. and Grewal J. S., 10th edition, Khanna Publishers, New Delhi, 2015.
3. A Textbook of Engineering Mathematics, N. P. Bali and Manish Goyal, 9th edition, Laxmi Publications, 2016.
4. Applied Numerical Analysis, Gerald. C.F. and Wheatley. P.O, 7th edition, Pearson Education India, 2007.

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Board of Studies of H&S dept.
Meeting No. 6 Dated: 31/05/2024

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WEB RESOURCES:

1. https://www.vyssotski.ch/BasicsOfInstrumentation/LaplaceTransform.pdf
2. https://www.sjsu.edu/me/docs/hsu-Chapter%206%20Laplace%20transform.pdf
3. https://www.maths.gla.ac.uk/~cc/2x/2005_2xnotes/2x_chap5.pdf
4. https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200403225057191 2siddharth_bhatt_engg_Interpolation.pdf
5. https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200403225057191 2siddharth_bhatt_engg_Numerical_Differentation_and_Integration.pdf

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=c9NibpoQjDk
2. https://www.youtube.com/watch?v=2LyY4t0Gfvs
3. https://www.youtube.com/watch?v=AIysepirN3w
4. https://archive.nptel.ac.in/courses/111/107/111107105/#
5. https://nptel.ac.in/courses/105105043

COURSE OUTCOMES

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

1. Apply Laplace transform techniques to solve engineering problems involving elementary, periodic, and piecewise functions. (K3)
2. Apply inverse Laplace transform techniques and related theorems to solve second-order linear differential equations. (K3)
3. Apply iterative and direct numerical methods to solve algebraic, transcendental, and linear systems of equations. (K3)
4. Apply Newton's and Lagrange's interpolation techniques to estimate values from discrete data. (K3)
5. Apply numerical techniques to approximate derivatives and evaluate definite single and double integrals. (K3)
6. Implement Python programming fundamentals and apply numerical computing libraries (NumPy, SciPy, matplotlib, SymPy) to solve engineering problems including equation solving, data interpolation, numerical differentiation, and integration using appropriate computational methods. (K3)

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

SEMESTER - III

24MUPW301 - SDG NO. 4,9,12,13	BASIC MANUFACTURING PROCESSES WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To implement the basics and in depth knowledge about Manufacturing Technology.
- To know the various basic Manufacturing processes used in industry for converting raw materials into finished products.
- To understand the concept and basic mechanics of metal cutting, working of standard machine tools.
- To study the working principles of plastic molding.
- To understand the concepts of non-traditional machining processes.

MODULE - I METAL CASTING AND JOINING PROCESSES **8**

Sand Casting – Type of patterns – Pattern Materials – Pattern allowances – Cores – Types. – Principle of special casting processes – Shell, Investment, Pressure die casting, Centrifugal Casting. Defects in Sand casting process-remedies. Gas welding process – Arc welding – TIG, MIG, SAW, PAW – Resistance welding Process – Types - Weld defects and remedies.

MODULE - II METAL DEFORMATION PROCESSES **8**

Hot working and cold working of metals – Forging processes – Typical forging operations. Rolling of metals - Types of Rolling. Drawing and Extrusion – Principles and types. Sheet metal characteristics – Shearing, bending and drawing operations – Stretch forming operations.

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Board of Studies of HAS dept.
Meeting No. 6 Dated: 21/06/2024

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Mechanical and Automation and Engineering

MODULE - III THEORY OF METAL CUTTING AND MACHINES **8**

Mechanics of chip formation – Forces in machining – Types of chip – cutting tool materials – cutting fluids. Lathe construction – specification – operations – taper turning methods – Capstan and turret lathes – automatic lathes - semi-automatic – Single spindle – Multi spindle. Drilling – Reaming – Boring – Tapping – Milling – operations – types of milling cutter – Gear shaping processes – Finishing of gears.

MODULE - IV ABRASIVE PROCESS AND BROACHING **7**

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding and internal grinding – Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines.

MODULE - V MANUFACTURE OF PLASTIC COMPONENTS **7**

Types and characteristics of plastics – Molding of thermoplastics & Thermosetting polymers – working principles and typical applications – injection molding – Plunger and screw machines – Compression molding, Transfer Molding – Typical industrial applications – Introduction to blow molding – Rotational molding – Film blowing – Extrusion.

MODULE - VI ADVANCED MACHINING PROCESSES **7**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications

TOTAL : 45 PERIODS

LIST OF EXPERIMENTS **15 PERIODS**

1. Fabricating simple structural shapes using Gas Metal Arc Welding machine.
2. Preparing green sand moulds with cast patterns.
3. Taper Turning and Eccentric Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Drilling and Reaming using vertical drilling machine.
6. Milling contours on plates using vertical milling machine.
7. Cutting spur and helical gear using milling machine.
8. Generating gears using gear hobbing machine.

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Meeting No. 6 Dated: 1/6/14

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Mechanical and Automation and Engineering

9. Grinding components using cylindrical and centerless grinding machine.
10. Grinding components using surface grinding machine.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Kalpak Jian. S, "Manufacturing Engineering and Technology", Pearson Education India, 7th Edition, 2018.
2. N Khurmi R.S Khurmi. "A Textbook of Workshop Technology: Manufacturing Processes", S Chand & Company, 16th Edition, 2021.

REFERENCE BOOKS

1. Hajra Choudhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008.
2. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", 3rd Edition, Tata McGraw-Hill, New Delhi, 2013.
3. Winston. A. Knight, Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools" CRC Press, 3rd Edition.
4. David A. Stephenson, John S. Agapiou. "Metal Cutting Theory and Practice" Taylor & Francis publisher, 2006
5. Vijay Kumar Jain. "Advanced Machining Processes" Allied publishers Pvt. Ltd, 2009.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/107/112107144/
2. https://nptel.ac.in/courses/112/105/112105127/
3. https://nptel.ac.in/courses/112/107/112107084/
4. https://nptel.ac.in/courses/112/106/112106153/
5. https://nptel.ac.in/courses/112/107/112107090/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/107/112107145/
2. https://nptel.ac.in/courses/112/105/112105126/
3. https://nptel.ac.in/courses/112/104/112104195/
4. https://nptel.ac.in/courses/112/107/112107219/
5. https://nptel.ac.in/courses/112/107/112107083/
6. https://nptel.ac.in/courses/112/107/112107215/
7. https://nptel.ac.in/courses/112/107/112107250/

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Meeting No. 6 Dated: 1/6/24

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8. https://nptel.ac.in/courses/112/104/112104290/
9. https://nptel.ac.in/courses/112/103/112103248/

OUTCOMES

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

1. Apply the knowledge of different casting and metal joining processes. (K3)
2. Interpret the characteristics, process details and applications of bulk deformation in metals. (K3)
3. Analyze the various tools, equipment, and machinery required for basic manufacturing processes. (K4)
4. Apply suitable molding technique for manufacturing of plastics components. (K3)
5. Develop the different metal removing, finishing and super finishing for component production. (K3)
6. Compare mechanical energy-based non-traditional machining processes and justify their applications for advanced materials. (K4)

CO – PO, PSO MAPPING:

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

Recommended by Board of Studies of MU dept. Meeting No. 6 Dated: 1/6/24

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SEMESTER - III

24ESEI302 - SDG NO. 3, 4, 11	BASIC ELECTRONICS AND CONTROL SYSTEM	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the concepts of Electronics devices and Circuits.
- To understand concepts related to analog and digital signal conditioning.
- To understand various systems and derive mathematical model of a system.
- To study time response of closed loop control systems.

MODULE - I SEMICONDUCTOR DIODES 7

Types of Materials - Silicon & Germanium- N type and P type materials - Structure, peration and Characteristics of Diodes - PN, Zener. Transistors - Bipolar Junction Transistor (NPN and PNP in CE, CB, CC configuration).

MODULE - II TRANSISTORS 7

Construction, Principle of Operation, Working and Characteristics of Field Effect Transistors - JFET, MOSFET, Thyristors - SCR and UJT.

MODULE - III OPERATIONAL AMPLIFIER AND ITS APPLICATIONS 7

Ideal Op-Amp –Block diagram, Inverting and Non-inverting amplifier, Instrumentation Amplifier, Differentiator, Integrator, Oscillator- Wein Bridge, Hartley and Crystal Oscillators.

MODULE - IV ELECTRONIC SIGNAL CONDITIONING CIRCUITS 8

Standard analog signals, sample and hold circuit, peak detector, ADC (Successive Approximation, Flash, Ramp, dual slope) and DAC (R/2R, Weighted resistors) their types and specifications

MODULE - V SYSTEMS AND THEIR REPRESENTATION 8

Basic elements in control systems- Open and closed loop system, Transfer function and Electrical analogy of mechanical translational and rotational systems- Block diagram reduction and Signal Flow graph.

Recommended by
Board of Studies of EIE dept.
Meeting No. 7 Dated: 01/03/25

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Electronics and Instrumentation Engineering
Humanities & Sciences

MODULE - VI TIME RESPONSE ANALYSIS OF SYSTEMS 8

Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Gupta S, "Electronic Devices & Circuits", DhanpatRai Publicaions.
2. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017

REFERENCE BOOKS

1. Boylestad and Nashelsky, "Electronic Devices and Circuit", Pearson Publisher, 2015
2. Ramakant Gayakwad, "Op-amp and Linear Integrated Circuits" , Fourth edition, PHI Pearson Education
3. Roy Choudhry, D,Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition
4. Salivahanan, S & V.S. KanchanaBhaskaran, —Linear Integrated Circuits||, TMH,2nd Edition,4th Reprint, 2016
5. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014

WEB RESOURCES:

1. https://www.newworldencyclopedia.org/entry/Electronic_engineering
2. https://www.tutorialspoint.com/control_systems/control_systems_useful_resources.htm

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117103063
2. https://nptel.ac.in/courses/107106081

OUTCOMES

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

1. Describe the operation and characteristics of various semiconductor devices and BJT. (K2)
2. Illustrate the working of various configurations of transistors and thyristors. (K2)
3. Analyse the configuration of operational amplifiers and oscillator circuits (K2)

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Meeting No. 7 Dated: 1/3/25

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4. Explain the concepts related to analog and digital conditioning. (K2)
5. Derive the mathematical model of electrical, mechanical systems and determine/reduce the transfer function for the system using block diagram reduction and signal flow graph methods (K3).
6. Derive the time domain behavior of I &II order systems (K3)

CO – PO, PSO MAPPING:

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

SEMESTER - III

24MUPC301 - SDG NO. 4,7,12,15	THERMODYNAMICS AND FLUID MECHANICS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the basics laws of thermodynamics.
- To understand the second law of thermodynamics
- To understand the laws of energy conversion cycles and various air standard cycles.
- To knowledge in Fluid Properties and Statics.
- To understand the concept of fluid kinematics and Dynamics.
- To learn about the flows in fluid, fluid losses and dimensional analysis.

MODULE - I BASICS OF THERMODYNAMICS AND FIRST LAW OF THERMODYNAMICS **8**

Thermodynamics – Microscopic and macroscopic point of view – Systems, properties, process, path, cycle. Thermodynamic equilibrium – Zeroth law of Thermodynamics – internal energy, enthalpy, specific heat capacities CV and CP, Relationship between CV and CP. First law of Thermodynamics – Application to closed and open systems – Steady Flow Energy Equation (SFEE) – Simple problems.

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MODULE - II SECOND LAW OF THERMODYNAMICS **7**

Limitations of First law of thermodynamics, Cyclic devices, Directional constraints. Thermal Energy reservoirs. Heat engines, refrigerators/heat pump, Statements – Kelvin- Planck & Clausius, Mathematical interpretations with efficiency, COP, Ton of Refrigeration, Equivalence of statements with illustrations, Perpetual motion machine of second kind (PMMSK/PMM-II). Reversibility and irreversibility – causes and conditions. Carnot Theorems, Absolute temperature scale.

MODULE - III MODELLING OF BASIC ENERGY CONVERSION CYCLES **8**

Air standard assumptions, Overview of reciprocating engines, Air standard cycles for reciprocating engines – Otto, Diesel & dual, Criteria for comparison & comparative analysis, Derivation for efficiency, Mean effective pressure (MEP) & Carnot efficiency, calculation of Heat transfer at mean temperature.

MODULE - IV FLUID PROPERTIES AND FLUID STATICS **7**

Fluid Definition and Classification – Properties of fluids: Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Compressibility, Bulk Modulus, Capillary and Surface Tension – Fluid statics: Concept of fluid static pressure – Pascal's law –Absolute and Gauge pressures – Manometers: Types and Pressure measurement – Concept of Buoyancy and Floatation.

MODULE - V FLUID KINEMATICS AND FLUID DYNAMICS **7**

Fluid Kinematics: Types of fluid flow – Continuity equation in two and three dimensions – Velocity and Acceleration of fluid particle – Velocity potential function and Stream function. Fluid dynamics: Euler's equation along a streamline –Bernoulli's equation and applications – Venturi meter, Orifice meter and Pitot tube.

MODULE - VI FLOW THROUGH PIPES AND DIMENSIONAL ANALYSIS **8**

Viscous flow: Shear stress, pressure gradient relationship – Flow of viscous fluid through circular pipe – Flow through pipes: Loss of head due to friction – Minor head losses – Hydraulic gradient and Total energy lines – Flow through pipes in series and in parallel – Power transmission through pipes. Dimensional analysis: Buckingham's pi theorem.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Nag P.K., Engineering Thermodynamics, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.

Recommended by
Board of Studies of MU dept.
Meeting No. 6 Dated: 1/6/16.

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2. Bansal R.K., Fluid Mechanics and Hydraulic Machines, 9th Edition, Laxmi Publications, New Delhi, 2015.

REFERENCE BOOKS

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics", Fifth Edition, Lakshmi Publications, 2017.
2. Cengel Yunus A. and Boles Michael A., Thermodynamics: An Engineering Approach, 7th Edition, McGraw-Hill, New York, 2011.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Frank M. White., Fluid Mechanics, 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.
5. R.K. Rajput, "Fluid Mechanics and Hydraulic Machines", S.Chand & Company Ltd, 2010.

WEB RESOURCES:

1. https://www.mcgoodwin.net/pages/thermodynamics.pdf
2. https://nptel.ac.in/courses/112105266
3. https://nptel.ac.in/courses/112/104/112104118/
4. https://nptel.ac.in/courses/112/104/112104117/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/102/112102255/
2. https://nptel.ac.in/courses/112/105/112105123/
3. https://nptel.ac.in/courses/101/104/101104063/
4. https://nptel.ac.in/courses/112/105/112105171/
5. https://nptel.ac.in/courses/105/101/105101082/
6. https://nptel.ac.in/courses/112/105/112105183/

OUTCOMES

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

1. Apply the fundamental principles of thermodynamics to analyze energy interactions in closed and open systems using the First Law of Thermodynamics and the Steady Flow Energy Equation (SFEE). (K3)
2. State and apply the second laws of thermodynamics for various thermal systems (K3)
3. Select suitable thermal systems for various thermal applications. (K3)
4. Apply the principles of fluid properties and statics to solve practical engineering problems and analyze real-world applications. (K3)

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5. Compare and contrast the different types of flows in a fluid motion, principles of continuity, momentum and energy as applied to fluid motions. (K3)
6. Develop a range of analytical fluid flow and apply dimensional analysis to predict physical parameters that impact the effectiveness. (K3).

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

SEMESTER - III

24MUPW302 - SDG NO. 4 & 9	SENSORS IN AUTOMATION WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To understand the concepts of measurement technology
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal data acquisition and communication systems used in automation system development.

MODULE - I INTRODUCTION **8**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors –Sensor Output Signal Types.

MODULE - II POSITION, MOTION AND RANGING SENSORS **8**

Position and Displacement sensors - Potentiometers, Resolver, Encoders, Inductive, Capacitive, LVDT, RVDT. Motion Sensors - Accelerometer, GPS, Bluetooth, Range Sensors - Ultrasonic Ranging, Laser Range Sensor (LIDAR).

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MODULE - III FORCE, MAGNETIC AND HEADING SENSORS 7

Strain Gauge, Load Cell, Magnetic Sensors - types, principle, requirement and advantages: Magneto resistive, Hall Effect, Current sensor. Heading Sensors - Compass, Gyroscope and Inclinometers.

MODULE - IV PRESSURE AND TEMPERATURE SENSORS 7

Pressure - Diaphragm, Bellows, Piezoelectric - Tactile sensors. Temperature - IC, Thermistor, RTD, Thermocouple.

MODULE - V OPTICAL, ACOUSTIC AND SMART SENSORS 7

Photo conductive cell, photo voltaic, Photo resistive, LDR - Fiber optic sensors. Acoustic Sensors - flow and level measurement, Radiation Sensors - Smart Sensors, MEMS.

MODULE - VI DAQ SYSTEMS AND APPLICATIONS 8

Data Acquisition: Single channel and multi-channel data acquisition - Data logging - Applications - Automobile, Home appliances, Manufacturing, Environmental monitoring.

TOTAL : 45 PERIODS

LABORATORY EXPERIMENTS: **TOTAL: 15 PERIODS**

1. Displacement versus output voltage characteristics of a potentiometric transducer.
2. Characteristics of Strain gauge and Load cell.
3. Characteristics of LVDT and Photoelectric transducer.
4. Characteristic and Step response of RTD.
5. Characteristic and Step response of Thermocouple.
6. Characteristic and Thermistor.
7. Measurement of Angular displacement using resistive and capacitive transducer.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 7th Edition, 2019.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai& Co, New Delhi, 2017.

Recommended by
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Meeting No. 6 Dated: 1/6/22

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REFERENCE BOOKS:

1. Sujatha, C., Dyer, S.A., "Survey of Instrumentation and Measurement", John Wiley & Sons, Canada, 2004.
2. Hans Kurt Tönshoff (Editor), Ichiro, "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
4. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015

WEB RESOURCES:

1. https://electronics-tutorials.ws/io/io

ONLINE RESOURCES:

1. https://instrumentationtools.com/tag/sensors-and-transducers-nptelpdf/
2. https://swayam.gov.in/nd1_noc19_ee41/preview
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf

OUTCOMES

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

1. Apply the understanding of static and dynamic characteristics of transducers to analyze sensor performance and evaluate their impact on measurement accuracy (K3)
2. Apply the working principles of various position, motion, and range sensors to select suitable sensors for various engineering systems. (K3)
3. Apply the operating principles of force, magnetic, and heading sensors to practical measurement problems in mechanical systems. (K3)
4. Demonstrate the principles of various pressure and temperature sensors (K3)
5. Apply the concepts of optical, acoustic, and smart sensors, including MEMS, for sensing light, sound, and environmental parameters in smart system design. (K3)
6. Identify the suitable DAQ systems with different sensors for 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	1	-	1	-	-	-	1	-	-	-	-	1	1
CO2	1	1	2	1	-	1	1	1	-	-	-	1	2
CO3	1	-	-	1	1	-	-	-	-	-	-	1	1
CO4	1	-	-	-	2	1	1	1	-	-	-	1	1
CO5	1	-	-	-	2	1	1	1	-	-	-	1	2
CO6	1	1	2	1	2	1	1	1	1	-	1	1	2

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 of relationship
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

ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

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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

BORDER & COASTAL AREAS **2**

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

TOTAL :45 PERIODS

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SEMESTER - III

24MUPL301 - SDG NO. 4,8,9,12	COMPUTER AIDED DRAFTING LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To impact the students with necessary computer aided modeling skills using standard CAD packages.
- To acquire the knowledge of CAD software and its features
- To familiarize the students with Indian Standards on drawing practices.
- To impact knowledge of thread forms, fasteners, keys, joints and couplings.
- To make the students understand and interpret drawings of machine components leading to preparation of assembly drawings manually and using CAD packages.

LIST OF EXPERIMENTS USING SOFTWARE CAPABLE OF DRAFTING AND MODELLING:

1. Creation of simple figures like polygon and general multi-line figures.
2. Drawing of curves like parabola, spiral, involute using B-spline or cubic-spline.
3. Drawing front view, top view and side view of objects from the given pictorial view.
4. Drawing of a simple steel truss.
5. Drawing isometric projection of simple objects.
6. Creation of 3D models of simple objects and obtaining 2D multi-view drawings from 3D model.
7. Creating 3D features (Extrude & Revolve)
8. Drawing of 3D working tools like Hole, Round and Chamfer.
9. Creating of 3D Piston models using 3D software.
10. Develop a 3D drawing of Universal Joint using 3D software.

LIST OF EQUIPMENTS:

1. IBM Server, Intel Xeon 5506, (Quad Core- NEHELAM) – 1.
2. Dell Optiplex 3040 Desktop, 6th Gen Intel Core i5 Processor with suitable graphics facility 4GB Ram, 1TB Hard Disk.
3. Licensed software for Drafting and Modeling- 30 Licenses
4. Laser Printer or Plotter - to print/Plot drawings.

TOTAL : 45 PERIODS

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OUTCOMES

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

1. Apply fundamental AutoCAD commands to create, modify, annotate, and plot 2D technical drawings effectively. (K3)
2. Construct basic 3D models and generate plots for simple objects using AutoCAD tools. (K3)
3. Develop part and assembly drawings in accordance with standard engineering drawing conventions. (K4)

CO – PO, PSO MAPPING:

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

SEMESTER - III

24MUTP301 - 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 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

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

OBJECTIVES:

- Familiarize the team and leadership skills.
- Gain Scouting spirit.
- Understand the standards relevant to Mechanical.

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.

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MODULE - III INTRODUCTION OF STANDARDS & TECHNICAL DRAWINGS **8**

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.

World of Standards: Important Indian and International Standards.

Technical Drawings: Types of projections; representation of lines, view, sections and cuts. Standardized representation of threads, fasteners, welds, bearings, springs and related components. Limits, fits and tolerances, dimensional and geometric tolerances, surface finish symbols.

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://www.cambridgeenglish.org/learning-english
2. https://lms.scout.org/course_items/show/1172182?course_id=214307#course-item-id=1172182
3. https://lms.scout.org/courses/show/214123?force_course_hub=true

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. Explain the fundamental concepts, processes, and significance of

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standardization and interpret standardized technical drawings and symbols used in engineering design. (K2)

CO – PO, PSO MAPPING:

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

SEMESTER - III

24MUID301 - SDG NO. 4,8,9,12	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

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)

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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

24MUPC401 - SDG NO. 3, 4, 11	FLUID POWER AUTOMATION	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
- To train the students in designing the hydraulic and pneumatic circuits using various design procedures.

MODULE - I INTRODUCTION TO FLUID POWER PRINCIPLES 7

Introduction to Fluid Power Automation: Definition; Basics of Hydraulics – Pascal's Law – Principles of flow; properties of fluids; Benefits and Impact of Automation on Manufacturing and Process Industries. Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatic – Selection criteria.

MODULE - II HYDRAULIC SYSTEM AND COMPONENTS 7

Source of Hydraulic power: pumping theory –pump classification - Gear pump, vane pump, piston pump, construction and working of pumps- pump performance - Variable displacement pump. Linear Hydraulic actuators – Types of hydraulic cylinders-single acting, double acting, Special Types like Tandem and Telescopic, mounting details, cushioning –accumulators and their types.

MODULE - III PNEUMATIC SYSTEM AND COMPONENTS 7

Pneumatics: Properties of air - Perfect Gas Laws – Pneumatic actuator types linear and rotary- Compressor - Filters, Regulator, Lubricator Unit - Muffler- Air control Valves, Quick Exhaust Valves

MODULE - IV FLUID POWER CONTROL ELEMENTS 7

Direction, Flow and pressure control valves – Types, Construction and Operation –Servo and Proportional valves–Solenoid valves- Applications – Accessories: Reservoirs, Pressure Switches – Applications.

MODULE - V CIRCUIT DESIGN 8

Basic Hydraulic Circuits: Meter in, Meter out and Bleed off circuits; Intensifier circuits, Regenerative Circuit, Counter balance valve circuit and sequencing circuits. Pneumatic Circuit Designing: Design of Pneumatic sequencing

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circuits using Cascade method and Shift register method (up to 3 cylinders), Design of Pneumatic circuits for Pick and Place applications.

MODULE - VI DESIGN AND CONTROL OF ELECTRO-PNEUMATIC SYSTEMS **9**

Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping; Design of Pneumatic circuits using PLC Control (ladder programming only) up to 2 cylinders, with applications of Timers and Counters and concept of Flag and latching.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications', 7th Edition, Pearson Education Limited, 2013.
2. Bolton, W., "Mechatronics, Electronic control systems in Mechanical and Electrical Engineering", 6th Edition, Pearson Education, 2015.

REFERENCES:

1. Dudbey. A., Peace, "Basic Fluid Power", 2nd Edition, Prentice Hall Inc, 1986.
2. Fitch, E.C., and Suryaatmadyn, J.B., "Introduction to fluid logic", McGraw Hill, 1978.
3. Herbert R. Merritt, "Hydraulic control systems", John Wiley & Sons, Newyork, 1967.
4. Peter Rohner, "Fluid Power Logic Circuit Design", McmelanPrem, 1994.

WEB RESOURCES:

1. http://link.springer.com/content/pdf/bfm%3A978-1-349-16126-3%2F1.pdf
2. https://yuken-usa.com/pdf/special/Basic_Hydraulic_And_Components_(Pub._ES-100-2)_.pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112105206
2. https://www.iitp.ac.in/~athakur/courses/MH501/ModuleIV/Hydraulic%20Systems.pdf
3. https://nptel.ac.in/courses/112105206
4. https://www.haenchen-hydraulic.com/media/pdf/en/en_preview-book-hydraulic-systems.pdf?m=1582719423&

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OUTCOMES

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

1. Choose the basic automation techniques for small manufacturing set-ups. (K3)
2. Explain the working principles of fluid power components such as pumps and motors. (K3)
3. Design pneumatic and hydraulic circuits of moderate complexity. (K3)
4. Analyze the operation of control and regulation elements in pneumatic and hydraulic systems. (K4)
5. Demonstrate the application of electrical and electronic controls in fluid power circuits. (K3)
6. Design the electro pneumatic circuits using solenoid valves and PLC control. (K4)

CO – PO, PSO MAPPING:

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

SEMESTER - IV

24MUPC402 - SDG NO. 4, 9	THEORY OF MACHINES	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- Understand the fundamental concepts of mechanisms.
- Understand the functions of cams, gears, and flywheel.
- Impart knowledge on design of mechanisms and dynamic loads acting on the mechanism.
- Give an insight on the concepts of balancing, vibration and speed governing devices.

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MODULE - I MECHANISMS AND KINEMATICS 7

Introduction, mechanisms and machines, terminology, planar mechanism - Kinematic diagram and inversion, Mobility, Coincident joints, Grubbler and Grashoff's law, Four bar, single and double slider mechanisms and their inversions. Introduction to Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

MODULE - II GEARS AND GEAR TRAINS 8

Gear terminology, law of gearing- nomenclature of spur & helical gears – interference – requirement of minimum number of teeth in gears. Simple, Compound and reverted gear trains -determination of speed and torque in epicyclic gear trains.

MODULE - III KINEMATIC ANALYSIS OF CAMS 7

Types of cams, Types of followers. Displacement, Velocity and acceleration time curve for cam profiles. Follower motions including SHM, Uniform acceleration and retardation and Cycloidal motion.

MODULE - IV BALANCING 8

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder Inline, V-engines – Partial balancing in engines – Balancing machines.

MODULE - V VIBRATION 7

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

MODULE - VI MECHANISMS FOR CONTROL 8

Governors – Types: Centrifugal governors – Gravity controlled and spring controlled governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rattan S.S, "Theory of Machines", Tata McGraw Hill Publishing Company Ltd., New Delhi, 4thEdition, 2014.

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2. Khurmi, R. S., Gupta, J. K.,"Theory of Machines", S.Chand Publisher, 14th Edition, 2020.

REFERENCE BOOKS

1. Sadhu Singh, "Theory of Machines:Kinematics and Dynamics", Pearson Education, 3rd Edition, 2011.
2. John Joseph Uicker, Pennock,G. R., Joseph Edward Shigley, 'Theory of Machines and Mechanisms', Oxford University Press, 2003.
3. Amitabha Ghosh and Mallick, 'Theory of Machines and Mechanisms', East West Press, 3rdEdition 2020.
4. Thomas Bevan, "Theory of Machines", CBS Publication, 3rd Edition,2005.
5. Singh, V.P.,"Mechanical Vibrations", Dhanpat Rai Publications (P) Ltd, 3rd Edition, 2011.

WEB RESOURCES:

1. https://www.tutorialspoint.com/theory-of-machines/index.asp
2. https://mechanicalbasics.com/theory-of-machines/
3. https://en.wikipedia.org/wiki/Outline_of_machines?utm_source=chatgpt.com

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104121/
2. https://archive.nptel.ac.in/courses/112/106/112106270/
3. https://archive.nptel.ac.in/courses/112/105/112105268/
4. https://archive.nptel.ac.in/courses/112/104/112104114/

OUTCOMES

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

1. Solve problems related to the motion of planar mechanisms using kinematic diagrams and laws. (K3)
2. Calculate speed and torque in different gear train configurations using gear ratio principles. (K3)
3. Construct displacement, velocity, and acceleration diagrams for cam-follower systems using standard motion curves. (K3)
4. Analyze techniques for balancing rotating and reciprocating systems to control vibration (K4)
5. Solve problems involving free, forced, and damped vibrations in single-degree-of-freedom mechanical systems. (K3)

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6. Examine the working principles of governors and gyroscopes to analyze system stability and control. (K4)

CO – PO, PSO MAPPING:

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

SEMESTER - IV

24MUPC403 - SDG NO. 3, 4, 11	ROBOTS AND SYSTEMS IN SMART MANUFACTURING	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To get a knowledge of working on Industrial robots and their load handling capacity, applications in machine cells and FMS.
- To do a detailed analysis about robotization and its economics with an application of robots in various industrial operations.
- To familiar with construction and working of material handling system.
- To learn software usage, automation in material handling and storage.
- To impart the knowledge on robotic simulation and programming.
- To obtain the knowledge on various type of robot welding and multiple operations.

MODULE - I INTRODUCTION OF ROBOTICS IN MATERIAL HANDLING APPLICATIONS **8**

Types of industrial robots - Load handling capacity - general considerations in Robotic material handling-material transfer - machine loading and unloading - CNC machine tool loading - Robot centered cell.

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MODULE - II SELECTION OF ROBOTS AND INDUSTRIAL IMPLEMENTATIONS **8**

Factors influencing the choice of a robot - robot performance testing - economics of robotization - Impact of robot on industry and society. Application of Robots in continuous arc welding - Spot welding - Spray painting -assembly operation - cleaning - robot for underwater applications.

MODULE - III MATERIAL HANDLING EQUIPMENTS **8**

Concepts of material handling - principles and considerations in material handling systems design - conventional material handling systems - industrial trucks - monorails - rail guided vehicles - conveyor systems -cranes and hoists.

MODULE - IV ADVANCED MATERIAL HANDLING, STORAGE AND AUTOMATION SYSTEMS **7**

Advanced material handling systems - automated guided vehicle systems - automated storage and retrieval systems (ASRS) - bar code technology - radio frequency identification technology -Introduction to Automation Plant design software.

MODULE - V ROBOTIC PROGRAMMING FOR INDUSTRIAL NEEDS **7**

Motion control, Types of motion control, Programmable and flexible control facility –Introduction-Types- Flex Pendant-Lead through programming, Operating mode of robot, Jogging-Types, programming for robotic operations.

MODULE - VI ROBOTIC APPLICATIONS IN MULTIPLE FIELDS **7**

Application of robot in manufacturing: Robots for box fabrication, robots for microelectronic welding and soldering – Applications in nuclear, aerospace and ship building, case studies for simple and complex applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Richard D Klafter, Thomas Achmielewski, Mickael Negin , "Robotic Engineering – An Integrated Approach", Prentice Hall India, New Delhi, 2006.
2. Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, New York, 2021.

REFERENCE BOOKS:

1. Pires J N, Loureiro A, Bolmsjo G, "Welding Robots: Technology, System Issues and Application", Springer, London, 2010.

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2. Parmar R S, "Welding Processes and Technology", Khanna Publishers, New Delhi, 2nd Edition, 2013.
3. John A. piotrowski, William T. Randolph, "Robotic welding: A Guide to Selection and Application, Welding Division, Robotics International of SME", Publications Development Dept., Marketing Division, 1987.
4. Mikell P Groover, Mitchel Weiss, Roger N Nagel, N.G.Odrey, Ashish Dutta, "Industrial Robotics (SIE): Technology, Programming and Applications", 2nd Edition, McGraw Hill Education India Pvt Ltd, 2017.
5. Yoram Koren, "Robotics for Engineers", McGraw-Hill, 1987.

WEB RESOURCES:

1. https://www.manufacturingtomorrow.com/article/2018/05/5-ways-robotics-are-being-used-in-smart-manufacturing/11568
2. https://robotnik.eu/smart-factories-robots/
3. https://www.slideshare.net/nabil130290/selection-of-robot
4. https://www.automationworld.com/factory/robotics/article/21133266/robots-how-to-choose-the-right-one
5. https://www.motoman.com/en-us/applications

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112107298
2. https://nptel.ac.in/courses/112107289
3. https://nptel.ac.in/courses/112104293

OUTCOMES

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

1. Discover about the usage of Industrial Robots and its considerations in Material handling, FMS, machine loading and machine centers. (K3)
2. Relate the robotization in terms of economics and categorize robots in welding, assembly and spray painting. (K4)
3. Utilize material handling equipment effectively in various industrial processes. (K3)
4. Infer various software advancements in material handling like automated storage and retrieval, data handling and plant automation (K4)
5. Develop robot programming for various industrial applications and to model simulation for industrial robotic applications. (K3)
6. Identify the various applications of robots in multiple industrial scenarios. (K3)

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CO – PO, PSO MAPPING:

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

SEMESTER - IV

24MUPW401 – SDG NO. 4,8,9,12,16	CNC AND METROLOGY WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To study the basic concepts of CNC and constructional features of CNC.
- To learn the basics of CNC programming concepts to develop the part programme for Machine centre and turning centre
- To Generate CNC programs for popular CNC controllers
- To learn basic concepts of linear, angular and transmission elements.
- To provide the knowledge of the advancement in metrology

MODULE - I INTRODUCTION **7**

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, types of control systems, CNC controllers, characteristics, interpolators, CNC Machine building, structural details, configuration and design, different kinds of guideways.

MODULE - II DRIVES AND WORK HOLDING DEVICES **7**

Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Axis measuring system – synchro, synchro-resolver, gratings, types of fringe gratings, encoders, work holding devices for rotating and fixed work parts

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MODULE - III CNC PROGRAMMING **8**

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre (controllers such as Fanuc, Heidenhain, Sinumerik), generation of CNC codes

MODULE - IV LINEAR AND ANGULAR MEASUREMENTS **8**

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchangeability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications

MODULE - V MEASUREMENT OF TRANSMISSION ELEMENTS AND TOLERANCE ANALYSIS **7**

Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness. Tolerancing– Interchangeability, Tolerance representation, Terminology, Limits and Fits

MODULE - VI ADVANCES IN METROLOGY **8**

Basic concept of lasers, Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications, Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Applications.

TOTAL : 45 PERIODS

LIST OF EXPERIMENTS: **TOTAL : 15 PERIODS**

MANUAL PART PROGRAMMING

1. CNC Machining Centre
   - i) Linear Cutting.
   - ii) Circular cutting.
   - iii) Cutter Radius Compensation.
   - iv) Canned Cycle Operations.
2. CNC Turning Centre
   - i) Straight, Taper and Radial Turning.
   - ii) Thread Cutting.
   - iii) Rough and Finish Turning Cycle.
   - iv) Drilling and Tapping Cycle.

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3. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge,
4. Calibration and use of measuring instruments depth micrometer, Comparators.
5. Measurement of angles using a bevel protractor, sine bar and autocollimator.
6. Measurement of transmission elements - screw thread parameters – Three wire method.
7. Measurement of gear parameters
8. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM).

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4th edition, 2018.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 22nd Edition, 2022.

REFERENCE BOOKS:

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India,7th Edition, 2018.
2. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2018.
3. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education ,6th Edition, 2013.
4. Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 1987.
5. Radhakrishnan P, "Computer Numerical Control Machines and Computer Aided Manufacturer", New Central Book Agency, 2018.

WEB RESOURCES:

1. https://www.matweb.com

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/106/112106138/
2. https://nptel.ac.in/courses/112/106/112106179/
3. https://nptel.ac.in/courses/112/104/112104250/
4. https://nptel.ac.in/courses/112/103/112103261/
5. https://nptel.ac.in/courses/112/106/112106140/
6. https://nptel.ac.in/courses/112/107/112107242/
7. https://nptel.ac.in/courses/112/107/112107259/

Recommended by Board of Studies of MU dept. Meeting No. 6 Dated: 1/6/24.

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OUTCOMES

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

1. Determine the fundamentals of CNC machines(K3)
2. Examine the various drives and Work holding devices used in CNC Machine tools. (K3)
3. Structure the programs for CNC machine tools(K4)
4. Explain the concepts of linear measurements applicable to various metrological instruments(K4)
5. Analyze the concepts of angular measurement as applied to various metrological instruments (K4)
6. Evaluate advancements in metrology through experimental investigation (K5)

CO – PO, PSO MAPPING:

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

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SEMESTER - IV

24CEPC405 105104160 SDG NO. 4, 9	STRENGTH OF MATERIALS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To calculate stresses and deformations in simple and compound bars under axial loads.
- To determine thermal stresses in bars and analyze principal stresses
- To solve problems involving stress and deformation in thin and thick pressure vessels.
- To analyze torsion problems in shafts and calculate stresses in helical springs
- To draw shear force and bending moment diagrams and compute bending stresses in beams
- To calculate beam deflections and determine buckling loads for columns.

MODULE - I STRESS, STRAIN & DEFORMATIONS OF SOLIDS 8

Definition of Stress and Strain – Tension, Compression and Shear Stresses. Stress-Strain relationship and Hooke's law. Deformation of simple bars and compound bars. Elastic constants and their relations.

MODULE - II THERMAL STRESSES AND ANALYSIS OF STATE OF STRESS 7

Thermal stresses – Bars in Series and Bars in Parallel. Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

MODULE - III THIN AND THICK SHELLS 7

Stresses and deformation in thin and thick cylinders subjected to internal pressure. Stresses and deformation in thin and thick spherical shells subjected to internal pressure.

MODULE - IV TORSION AND SPRINGS 7

Torsion Equation - Deformation in solid and hollows shafts, Stepped shafts. Stresses and deflection in closed coil helical springs with axial load.

MODULE - V STRESSES IN BEAMS 8

Transverse loading on beams – Shear force and bending moment diagram – Cantilever, simply supported and over hanging beams. Theory of simple bending – bending stress distribution.

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MODULE - VI DEFLECTION OF STRUCTURAL ELEMENTS **8**

Computation of slope and deflection in beams – Double Integration method, Macaulay's method.

Column - Computation of buckling load using Euler's Equation and Rankine Formula.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ferdinand P. Beer and E. Russell Johnston Jr., "Mechanics of Materials", 7th Edition in S.I. Units, McGraw Hill Education (India) Pvt. Ltd., 2017.
2. Bansal, R.K., "A Text Book of Strength of Materials", Laxmi Publications (P) Ltd. New Delhi, 2024.

REFERENCES:

1. Rajput, R.K., "A Textbook of Strength of Materials (Mechanics of Solids) SI Units, 7/e (LPSPE)", S. Chand Publications, 2022.
2. Jindal U.C., "Strength of Materials", 2nd Edition, Pearson India Education, 2018.
3. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2016.
4. Hibbeler, R.C., "Mechanics of Materials", Pearson India Education, 2017.

WEB RESOURCES:

1. http://ocw.mit.edu/courses/mechanical-engineering
2. http://nitc.ac.in/index.php/?url=users/view/270/12/3

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/106/105106116/
2. https://nptel.ac.in/courses/112/106/112106141/
3. https://nptel.ac.in/courses/105/106/105106172/
4. https://nptel.ac.in/courses/112/107/112107146/
5. https://nptel.ac.in/courses/112/107/112107147/

OUTCOMES

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

1. Apply the concepts of stress and strain to determine the deformation of deformable bodies. (K3)
2. Determine the stresses developed due to thermal response and in inclined plane due to axial load. (K3)

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3. Compute the Stresses and deformation of thin and thick vessels subjected to internal pressure. (K3)
4. Calculate the dimensions and deformation of cylindrical member's subjected to torsional load. (K3)
5. Compute the stresses and dimensions of the structural member subjected to transverse load. (K3)
6. Determine the deflection in structural member subjected to transverse load and Axial Load. (K3)

CO – PO, PSO MAPPING:

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

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Meeting No. 98 Dated: 4/6/25

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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

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

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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: 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

24MUPL401 - SDG NO. 4,9,12,13	SOM AND FLUID POWER SYSTEMS LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To enable the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the mechanical properties of materials under externally applied loads
- To enable the students to have a clear understanding of the losses in pipe flow
- To understand the flow measurements.
- To analyses the Performance of various Pumps and Turbines
- To know Microprocessor programming
- To design, model and analyse basic Electrical, Hydraulic & Pneumatic Systems

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Determination of friction factor for a given set of pipes.
9. Conducting experiments and drawing the characteristic curves of centrifugal pump/submergible pump
10. Conducting experiments and drawing the characteristic curves of reciprocating pump.
11. Conducting experiments and drawing the characteristic curves of Gear pump.
12. Stepper motor interface.
13. Traffic light interface.
14. Speed control of DC motor.
15. Study of various types of transducers.
16. Study of hydraulic, pneumatic and electro-pneumatic circuits.
17. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.

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18. Study of PLC, Design and Development of Colour Sorting Conveyor system, Pick and place conveyor system using sensors and PLC.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Universal Tensile Testing machine with double shear attachment – 40 Ton Capacity.
2. Torsion Testing Machine (60 NM Capacity).
3. Impact Testing Machine (300 J Capacity).
4. Brinell Hardness Testing Machine.
5. Rockwell Hardness Testing Machine.
6. Spring Testing Machine for tensile and compressive loads (2500 N).
7. Pipe Flow analysis setup.
8. Centrifugal pump/submergible pump setup.
9. Reciprocating pump setup.
10. Gear pump setup.
11. Basic Pneumatic Trainer Kit with manual and electrical controls/ PLC Control each.
12. Basic Hydraulic Trainer Kit.
13. Hydraulics and Pneumatics Systems Simulation Software.

TOTAL : 45 PERIODS

OUTCOMES

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

1. Explain and perform different destructive testing's such as Tension test, Shear test, Impact test, Hardness test to estimate the strength under externally applied loads with due consideration to safety. (K3)
2. Estimate the elastic constants of the given specimen through Deflection testing and spring testing with standard values. (K3)
3. Analyze fluid flow characteristics using flow measuring devices by calculating flow rate, frictional and minor losses in pipes, and demonstrate control system operations using PLCs and microcontrollers (K4)

CO – PO, PSO MAPPING:

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

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SEMESTER - IV

24MUPT401 - SDG NO. 4,9,12	ADDITIVE MANUFACTURING LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- To expose and train students in various Additive Manufacturing (AM) techniques for producing physical components across industrial applications.
- To familiarize students with software tools and data processing methods that support product development and prototyping.
- To enable students to apply concepts of vat polymerization in the fabrication of components.
- To provide understanding and application of powder bed fusion and direct energy deposition processes.
- To impart knowledge on the principles and applications of binder jetting and material jetting processes.
- To introduce the sheet lamination process, including Laminated Object Manufacturing (LOM), and evaluate its role in AM.

MODULE - I INTRODUCTION TO ADDITIVE MANUFACTURING 2+8

Overview - Need and Development of Additive Manufacturing (AM) Technology: Rapid Prototyping - Rapid Tooling – Rapid Manufacturing. AM Process Chain - Classification - Benefits.

List of Experiments

1. Introduction to Additive Manufacturing.
2. Generating STL files from the CAD Models & Working on STL files.

MODULE - II DESIGN FOR ADDITIVE MANUFACTURING (DFAM) 2+8

Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization - DFAM for Part Quality Improvement. Data Processing - CAD Model Preparation

List of Experiments

1. Processing the CAD data in open source software.
2. Simulation in Catalyst Software for optimizing build-time and material consumption.

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MODULE - III VAT POLYMERIZATION **2+8**

Photo polymerization - Stereo lithography Apparatus (SLA) - Materials - Process –Advantages - Limitations- Applications. Digital Light Processing (DLP) - Materials – Process - Advantages - Applications.

List of Experiments

1. Fabricating physical part on SLA 3D printer for the automotive applications.
2. Fabricating physical part on SLA 3D printer for manufacturing applications.

MODULE - IV POWDER BED FUSION **2+8**

Powder Bed Fusion: Selective Laser Sintering (SLS): Process – Powder Fusion Mechanism – Process Parameters – Typical Materials and Application.

List of Experiments

1. 3D Modeling & NC Code Generation–Flange of Flange Coupling
2. 3DModeling & NC Code Generation – Tapper Key & Shaft of Flange Coupling

MODULE - V DIRECT ENERGY DEPOSITION **2+8**

Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Materials – Process - Advantages and Applications. Beam Deposition Process: Laser Engineered Net Shaping (LENS) - Process -Material Delivery - Process Parameters -Materials -Benefits -Applications.

List of Experiments

1. 3D Modeling & NC Code Generation –Hex Nut &Bolt of Flange Coupling
2. 3D Printing of Fork, Centre Block & Key of Universal Coupling

MODULE - VI OTHER ADDITIVE MANUFACTURING PROCESSES & POST PROCESSING TECHNIQUES **2+8**

Binder Jetting: Three Dimensional Printing - Materials -Process - Benefits and Limitations. Material Jetting: Multi-jet Modeling- Materials - Process - Benefits. Sheet Lamination Process: Laminated Object Manufacturing (LOM)

List of Experiments

1. Removing the supports & post processing (cleaning the surfaces).
2. Evaluating the quality of the fabricated part in terms of surface finish and dimensional accuracy.

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. Andreas Gebhardt and Jan-Steffen Hotter, "Additive Manufacturing: 3DPrinting for Prototyping and Manufacturing", Hanser publications, United States, 2015
2. Ian Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", 2ndedition, Springer, United States, 2015.

REFERENCE BOOKS:

1. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015.
2. Andreas Gebhardt, "Understanding Additive Manufacturing: RapidPrototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011.
3. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States, 2006.
4. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011.
5. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016.

WEB RESOURCES:

1. https://www.sculpteo.com/en/3d-printing/3d-printing-technologies/
2. https://all3dp.com/1/types-of-3d-printers-3d-printing-technology/
3. https://3dprinting.com/what-is-3d-printing/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/107/103/107103081/
2. https://www.coursera.org/learn/3d-printing-software
3. https://nptel.ac.in/courses/112/104/112104225/

OUTCOMES

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

1. Discover about the usage of AM for various manufacturing industries. (K3)
2. Apply the principles of Design for Additive Manufacturing (DFAM) (K3)
3. Apply the steps involved in transforming a concept into a final product using Additive Manufacturing (AM) technology. (K3)

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4. Demonstrate the working principles and practical applications of vat polymerization and material extrusion processes. (K3)
5. Apply the techniques of powder bed fusion and direct energy deposition in relevant manufacturing scenarios. (K3)
6. Apply binder jetting, material jetting, and sheet lamination processes to appropriate materials by evaluating their procedures, benefits, and limitations. (K3)

CO – PO, PSO MAPPING:

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

SEMESTER - IV

24MUTP401 - 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.

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- 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.

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
2. Programming in ANSI C – E. Balagurusamy
3. The C Programming Language – Brian W. Kernighan and Dennis M. Ritchie
4. C: How to Program – Paul Deitel and Harvey Deitel
5. Problem Solving and Program Design in C – Jeri R. Hanly and Elliot B. Koffman

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

OBJECTIVES:

- Implement strategies to learn career and managerial skills for career growth.
- Understand the standards relevant to Mechanical.

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 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 STANDARDS AND APPLICATIONS OF MECHANICAL TESTING AND FERROUS & NON-FERROUS METALS 6

Mechanical testing of metals: Brief introduction of Indian standards on destructive testing of metals. Important test methods explained in brief like scope, principle of test, test piece dimensions, method of test, representation of the results and report of the test. Test covered are tensile test, hardness tests- Vickers, Brinell, Rockwell and Charpy impact test

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Applications of ferrous and non-ferrous metals: Brief introduction of important standards on ferrous and non-ferrous products. Examples of various applications of ferrous and non-ferrous metals. i.e. Steel Tubes & Pipes, Structural steel, wear and abrasion resistant steel, Weathering steel, Galvanized steel, automotive steel, precoated and painted steel, stainless steel, low nickel stainless steel, alloy steel, cold heading steel, aluminium for castings, EC grade aluminium, copper rods for electrical purpose, Copper sheets, non-ferrous metals standards for trade on exchanges etc. Terminology standards of ferrous and non-ferrous metals.

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

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. Explain the principles of standardized mechanical testing methods and illustrate the applications of ferrous and non-ferrous metals in accordance with relevant Indian standards. (K2)

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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	2	2	2	1	-	-	-	1	-	2	-	-
CO5	-	-	-	-	-	3	-	-	1	-	2	2	2
CO6	-	-	-	-	-	3	-	-	1	-	2	2	2

SEMESTER - IV

24MUID401 - 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.
- 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.

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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)

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)

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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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Board of Studies of MU dept.
Meeting No. 6 Dated: 11/4/24.

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SEMESTER V

COURSE CODE: 24MUPC501	MACHINE DESIGN	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108106191	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11, 12				
PRE-REQUISITE COURSES	24ESCE201, 24CEPC405					

OBJECTIVES:

- To understand basic concepts of machine design and stress analysis.
- To learn the design and working of different types of bearings.
- To design flexible elements like belts, pulleys, and chains.
- To design power transmitting elements such as gears, keys, and couplings.
- To understand and design different types of gearboxes.
- To apply Finite Element Analysis (FEA) for solving simple engineering problems.

MODULE - I STEADY STRESSES IN MACHINE MEMBERS 8

Introduction to the design process – factor influencing machine design, selection of materials based on mechanical properties – Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principal stresses for various load combinations, eccentric loading -Factor of safety - theories of failure – Design based on strength and stiffness.

MODULE - II DESIGN OF BEARINGS 7

Journal bearings – bearing materials, properties and mechanisms of lubrication, bearing modulus, coefficient of friction, minimum oil film thickness, heat generated and heat dissipated. Numerical examples on Sliding contact and Rolling Contact bearings.

MODULE - III DESIGN OF FLEXIBLE ELEMENTS 7

Design of Flat belts and pulleys - Selection of V belts and pulleys –Design of Transmission chains and Sprockets.

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MODULE - IV POWER TRANSMITTING ELEMENTS **8**

Gear materials – Design of straight tooth spur and helical gears based on life and wear considerations. Design Keys, Key ways and splines – Flexible couplings.

MODULE - V DESIGN OF GEAR BOXES **7**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout - Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box for machine tool applications – Variable speed gear box.

MODULE - VI FINITE ELEMENT ANALYSIS **8**

Basic Concept of Finite Element Method, Rayleigh Ritz method, Method of weighed residuals, Galerkin method. Governing differential equations of one- and two dimensional problems, One Dimensional Second Order Equations – Discretization – Linear and Higher order Elements - Interpolation and shape functions, Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Solution of static problems.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Bhandari V B, Design of Machine Elements||, 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Reddy,J.N. "Introduction to the Finite Element Method", 4th Edition, Tata McGrawHill,2018.

REFERENCE BOOKS

1. Design Data Hand Book, PSG College of Technology, Coimbatore, 2013.
2. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2004.
3. Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, "Design of Machine Elements", 8th Edition, Printice Hall, 2004.
4. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
5. Tirupathi R.Chandrupatla and Ashok D.Belegundu, "Introduction to Finite Elements in Engineering", International Edition, Pearson Education Limited, 2014.

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WEB RESOURCES:

1. http://library.iiti.ac.in/?page_id=1477
2. https://www.machinedesignonline.com/
3. https://library.stanford.edu/guides/mechanical-engineering
4. https://www.classcentral.com/course/machine-design1-7404
5. https://vulcanhammer.net/wp-content/uploads/2017/01/ifem.pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/105/112105124/
2. https://nptel.ac.in/courses/112/106/112106137/
3. https://nptel.ac.in/courses/112103295
4. https://nptel.ac.in/courses/112104205

OUTCOMES:

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

1. Analyze the stresses in machine members under different loading conditions and evaluate suitable design criteria. (K4)
2. Examine the performance of sliding and rolling contact bearings based on lubrication, friction, and heat considerations. (K4)
3. Analyze the design parameters of flexible elements such as belts, pulleys, and chains for effective power transmission. (K4)
4. Evaluate the strength and performance of power transmitting elements including gears, keys, splines, and couplings. (K4)
5. Interpret gearbox configurations and analyze speed ratios and kinematic layouts for machine tool applications. (K4)
6. Apply and analyze finite element methods to solve one- and two-dimensional engineering problems and interpret stress results of mechanical components. (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	1	–	–	–	–	–	–	–	–	2	2
CO2	3	2	1	–	–	–	–	–	–	–	–	2	2
CO3	3	2	2	–	–	–	–	–	–	–	–	2	2
CO4	3	3	2	–	–	–	–	–	–	–	–	2	2
CO5	3	3	2	1	–	–	–	–	–	–	–	2	2
CO6	3	3	2	3	2	–	–	–	–	–	1	2	2

SEMESTER V

COURSE CODE: 24EEPW501	ELECTRICAL DRIVES AND ACTUATORS WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4
NPTEL CODE: 108106191	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand the operation and characteristics of power semiconductor devices and their role in electrical drives.
- To analyze the dynamics, stability, and selection criteria of electric drives.
- To apply the principles of DC motors and electronic drive circuits for speed and motion control.
- To understand the construction, control, and applications of stepper and servo motor drives.
- To evaluate the performance and control of AC motor drives used in industrial applications.
- To develop practical skills in testing, controlling, and implementing modern electrical drive systems.

MODULE - I POWER ELECTRONIC DEVICES AND DRIVER CIRCUITS 8

Study of Switching Devices – Relay and Types, Switching characteristics - SCR, TRIAC, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits.

Recommended in Board of Studies (BoS) Meeting No. 08 **held on** 06.01.2026

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MODULE - II FUNDAMENTALS OF ELECTRICAL DRIVES **7**

Concept of Electric Drive – Equations Governing Motor Load Dynamics – Steady State Stability – Multi Quadrant Dynamics: Acceleration, Deceleration, Torque, and Direction, Starting and Stopping.

MODULE - III DC MOTOR DRIVES **8**

DC Motors, PMDC Motor, BLDC motors and Servomotors – Types, Principle of Operation - EMF Equations – Speed- Torque characteristics - Driver Circuits. H Bridge Circuits.

MODULE - IV STEPPER AND SERVO MOTOR DRIVES **7**

Constructional Features – Principle of Operation – Types Stepper Motors – Position Control - Drive Circuits – Closed Loop Control - Modern Stepper Motors and Drives.

MODULE - V ADVANCED ELECTRICAL DRIVES AND EMERGING APPLICATIONS **8**

AC Permanent Magnet Synchronous Motors – Linear Electrical Motors – Variable Frequency Drives (VFD)– AC Servo Drives - Overview of Motion Control.

MODULE - VI INDUSTRIAL APPLICATIONS **7**

Electric Vehicle (EV) propulsion drives – Energy-efficient motor drives – Regenerative braking concepts – Renewable energy integrated drive systems – Smart drive technologies – Industrial case studies and applications.

LIST OF EXPERIMENTS: **15**

1. Switching Characteristics of MOSFET and IGBT.
2. Switching Characteristics of SCR and TRIAC.
3. Gate pulsation generation using PWM signals.
4. Speed Control of DC motor using Power Electronic Drive.
5. Speed Control of BLDC motor using Power Electronic Drive.
6. Speed Control of PMDC motor using Power Electronic Drive.
7. VFD control of Three Phase Induction Motor using Power Electronic Drive.

TOTAL : 60 PERIODS

Recommended in Board of Studies (BoS) Meeting No. 8 **held on** 6/1/26

R. Das

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TEXT BOOKS:

1. Bimbhra B.S., "Power Electronics", 6th Edition, Kanna Publishers, New Delhi, 2021.
2. Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2018. .

REFERENCES:

1. Pillai, S.K., "A First Course on Electrical Drives", 3rd Edition, New Age International Publishers, 2019.
2. Krishnan, R., "Electric Motor Drives: Modeling, Analysis and Control", 1st Edition, Prentice Hall, 2017.
3. Singh, M.D. and Kanchandani, K.B., "Power Electronics", 3rd Edition, McGraw Hill Education, 2019.
4. Bose, B.K., "Modern Power Electronics and AC Drives", 1st Edition, Pearson Education, 2020.
5. Vedam Subrahmanyam, "Electric Drives: Concepts and Applications", 2nd Edition, McGraw Hill Education, 2017.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee94/preview
2. https://www.digimat.in/nptel/courses/video/108104140/L01.html
3. https://www.youtube.com/watch?v=Ub-csHc4VhA
4. https://www.youtube.com/watch?v=EaENkSSUK-k
5. https://www.youtube.com/watch?v=QaLGo0R0SYU

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=k9miF1KeMr0
2. https://www.youtube.com/watch?v=UHsM3uN0c8g
3. https://www.youtube.com/watch?v=UejGsuDSA-I
4. https://www.youtube.com/watch?v=G3Cwrr_IUtQ
5. https://www.youtube.com/watch?v=nE4o4ANcvKc

OUTCOMES:

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

1. Explain the operating principles, characteristics, and applications of power semiconductor devices and driver circuits used in electrical drives. (K2)

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2. Analyze the performance of electric drives under various operating conditions, including starting, braking, stability, and four-quadrant operation. (K3)
3. Apply the principles of DC motors, PMDC motors, BLDC motors, and their drive circuits for speed and motion control applications. (K3)
4. Illustrate the operation and control of stepper and servo motor drives for position and speed control applications. (K3)
5. Evaluate the performance of AC motor drives, VFDs, PMSM drives, and motion control systems used in industrial automation. (K3)
6. Analyze advanced electrical drives for modern industrial applications. (K4)

CO - PO, PSO MAPPING:

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

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

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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.

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.

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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
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/

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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)
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

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SEMESTER V

COURSE CODE: 24MUPL501	DESIGN AND SIMULATION LABORATORY	L	T	P	CP	C
		0	0	4	4	2
NPTEL CODE: 130106003	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11, 12, 13, 15				
PRE-REQUISITE COURSES	24MUPL301					

OBJECTIVES:

- Analyzing the force and stress in mechanical components.
- Analyzing deflection in mechanical components.
- Analyzing thermal stress of mechanical components.
- Simulation of mechanical components using MAT LAB

LIST OF EXERCISES USING SOFTWARE CAPABLE OF DRAFTING AND MODELLING

1. Study of Basics in ANSYS
2. Stress analysis of a plate with a circular hole
3. Stress analysis of rectangular L bracket
4. Stress analysis of cantilever beam
5. Stress analysis of simply supported beam
6. Stress analysis of fixed beam
7. Stress analysis of an axi-symmetric component
8. Thermal stress analysis of a 2D component
9. Conductive heat transfer analysis of a 2D component
10. Convective heat transfer analysis of a 2D component
11. Mode frequency analysis of cantilever beam
12. Mode frequency analysis of simply supported beam
13. Harmonic analysis of a 2D component
14. Stress analysis of a truss
15. Introduction to MATLAB
16. Simulation of Spring-mass system using MATLAB
17. Simulation of cam and follower mechanism using MATLAB

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LIST OF EQUIPMENTS:

1. ANSYS Suite: Workbench, Mechanical, Fluent, or CFX (depending on simulation needs).
2. MATLAB & Simulink: With Toolboxes like Parallel Computing Toolbox for enhanced performance.
3. Prerequisites: Latest drivers for GPU, .NET Framework 4.8 or later, and Microsoft Visual C++ Redistributable.

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Find out the effect of force and impact of stress on the mechanical components. (K4)
2. Calculate the deflection occurring on the mechanical components. (K4)
3. Get a detailed understanding of the thermal stress creation and its mechanism of spreading in mechanical components. (K4)
4. Gain knowledge regarding the mechanism of heat transfer in mechanical components. (K5)
5. Find out the vibration effects on mechanical components. (K5)

CO - PO, PSO MAPPING:

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

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SEMESTER V

COURSE CODE: 24MUTP501	SKILL ENHANCEMENT	L	T	P	CP	C
		0	0	2	2	1
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9,11, 12, 13, 15				
PRE-REQUISITE COURSES	-					

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

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

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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 MECH

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

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 STANDARDS IN WELDING, CONVEYING SYSTEMS, BEARINGS & MATERIAL TESTING **6**

Welding Technology: Overview of different types of welding processes and standards related to welding (especially different types of welding consumables, code of practice, safety and quality management in the field of welding).

Mechanical testing of metals: Brief introduction of Indian standards on destructive testing of metals. Important test methods explained in brief like scope, principle of test, test piece dimensions, method of test, representation of the results and report of the test. Test covered are tensile test, hardness tests- Vickers, Brinell, Rockwell and Charpy impact test

Continuous Bulk Conveying System: Brief introduction to important terminology, design, and product standards related to Continuous Bulk Conveying System. This includes the selection and design of belt conveyors, specification for troughed belt conveyors, specification for screw conveyors for industrial use, chain conveyors - connector units, shackle type, specification for steel roller conveyors, specification for conveyor chains, chain-wheels, and attachments. Additionally, to discuss the maintenance and code of practices involved during the operation of conveying systems.

Rolling Bearings, wear and tear patterns on bearings: Rolling element endurance testing and analysis, test samples, test rig design, Classification of failure modes occurring in rolling bearings; Failure modes: Rolling contact fatigue, wear, corrosion, electrical erosion, plastic deformation, cracking and fracture; Failure Analysis.

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/

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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. Enhance verbal communication and comprehension skills through grammar and language exercises. [K2]
4. Use 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. (K3)
6. Apply principles and standards of welding, metal testing, conveying systems, and bearing analysis in industrial applications.

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	-	2	2
CO5	-	-	-	-	-	3	2	2	2	2	1	2	2
CO6	3	2	2	2	-	-	-	-	-	-	-	3	2

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SEMESTER V

COURSE CODE: 24MUID501	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, 24MUID301, 24MUID401					

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.

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.

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- 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

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)

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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	3
CO2	3	3	3	--	3	-	-	-	-	-	-	2	3
CO3	3	3	3	-	3	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MUEL501	INDUSTRIAL AUTOMATION FOR MANUFACTURING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 11210329	SYLLABUS VERSION 1.0	SDG NO. 9, 11, 13				
PRE-REQUISITE COURSES	24MUPW301					

OBJECTIVES:

- To impart the basic knowledge in automation of industrial processes.
- To learn the different automated flow lines in manufacturing industries.
- To explore the material handling and part identification techniques.
- To learn about control system, assembly system and testing in modern manufacturing industries

MODULE - I INTRODUCTION 7

Introduction- Automation in production system, Principles and strategies of automation, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms, Analysis of transfer lines without storage, Automated flow lines with storage buffers.

MODULE - II COMPUTER AIDED PROCESS PLANNING 7

Process planning–Computer Aided Process planning, types. Production Planning- Master production schedule, bill of material, inventory record, working of material requirements planning and its outputs.

MODULE - III SHOP FLOOR CONTROL 7

Shop floor control – phases of shop floor control, factory data collection system. Simulation - classification of simulation language, Building of simulation models using General Purpose Simulation System (GPSS) – Simulation of manufacturing shop and super market using GPSS.

MODULE - IV GROUP TECHNOLOGY & FMS 8

Group technology– Part classification and coding, cellular manufacturing, production flow analysis- Rank Order Clustering and Hollier method. Flexible Manufacturing System (FMS) and its planning and implementation,

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Automated assembly system – design and types of automated assembly systems, Analysis of multi station and single station assembly machine.

MODULE - V SUPERVISORY CONTROL AND DATA **7**

Supervisory Control and Data Acquisition (SCADA) based architectures. SCADA for process industries includes understanding of RTUs, Pumping stations, Evacuation processes, Mass Flow Meters and other flow meters, Leak-flow studies of pipelines, Transport Automation.

MODULE - VI DISTRIBUTION CONTROL SYSTEM **9**

Introduction to computer based industrial automation- Direct Digital Control (DDC), Distributed Control System (DCS) - Local Control Unit (LCU) architecture, LCU Process Interfacing Issues, Block diagram and Overview of different LCU security design approaches, Networking of DCS. Introduction to communication protocols- Profibus, Field bus, HART protocols. Data gathering, Data analytics, Real-time analysis of data stream from DCS.

TOTAL : 45 PERIODS

TEXT BOOK:

1. M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 5th Edition, Pearson Education, 2009.
2. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011.

REFERENCE BOOKS

1. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International, 2013.
2. Lukas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
3. N. Viswanandham, Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", 1st Edition, 2009.
4. H K Shivanand, —Flexible Manufacturing Systems||, New Age International, 1st Edition, 2006.
5. Frank Lamb, Industrial Automation: Hands-On, 1st Edition, McGraw-Hill Education, 2013.

WEB RESOURCES:

1. https://www.ti.com/applications/industrial/industrial-automation/overview.html

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2. https://mistralsolutions.com/product-engineering-services/industrial-automation/
3. https://www.machinemetrics.com/blog/industrial-automation
4. https://unitedcontrolengg.com/scada-systems-in-industrial-automation-complete-guide/
5. https://resources.l-p.com/glossary/distributed-control-systems-dcs-industrial-automation

ONLINE RESOURCES:

1. https://nptel.ac.in/syllabus/108108098/
2. https://onlinecourses.nptel.ac.in/noc21_me67/preview
3. https://nptel.ac.in/courses/112103293

OUTCOMES:

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

1. Analyze the cost effectiveness of automated system in industrial automation. (K4)
2. Evaluate the relationship between MPS, BOM, and inventory records in achieving efficient production planning. (K4)
3. Examine the role of factory data collection systems and simulation of a manufacturing shop using GPSS for improving production performance. (K4)
4. Infer the concept of group technology and FMS in industrial automation with its applications. (K4)
5. Analyze the architecture of Supervisory Control and Data Acquisition (SCADA) systems used in industrial automation. (K4)
6. Inspect the distributed control system for Industrial automation. (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	2	-	-	-	-	-	2	-	2	2
CO2	3	3	2	3	-	-	-	-	-	3	-	3	3
CO3	2	3	2	3	3	-	-	-	-	2	-	3	3
CO4	2	3	3	2	3	-	-	-	-	3	-	3	3
CO5	2	3	2	3	3	-	-	-	-	2	-	2	2
CO6	2	3	3	2	2	-	-	-	-	3	-	2	2

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MUEL502	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112103280	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11, 12				
PRE-REQUISITE COURSES	24MUPC403					

OBJECTIVES:

- To expose potential alternate fuels and their characteristics
- To use appropriate synthetic fuels and fuel additives for better combustion characteristics
- To utilise alcohol fuels effectively for lower emissions
- To elaborate on the utilisation of Bio-Diesel and its types as a suitable fuel in CI engines
- To utilise different gaseous fuels and predict their performance and combustion characteristics

MODULE - I INTRODUCTION 7

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

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MODULE - II PROBLEM SOLVING **8**

Solving problems by searching - Informed search and exploration - Constraint satisfaction problems - Adversarial search, knowledge and reasoning-knowledge representation - First order logic.

MODULE - III PLANNING **8**

Planning with forward and backward State space search - Partial order planning - Planning graphs - Planning with propositional logic - Planning and acting in real world.

MODULE - IV REASONING **8**

Uncertainty - Probabilistic reasoning - Filtering and prediction - Hidden Markov models - Kalman filters - Dynamic Bayesian Networks, Speech recognition, making decisions.

MODULE - V LEARNING **7**

Forms of learning - Knowledge in learning - Statistical learning methods - reinforcement learning, communication, perceiving and acting, Probabilistic language processing, and perception.

MODULE - VI AI FOR ROBOTICS **7**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India, 2016.
2. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems", Harlow: Addison Wesley, 2002.

REFERENCES:

1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.
2. Robin Murphy, Robin R. Murphy, Ronald C. Arkin, "Introduction to AI Robotics", MIT Press, 2000.

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3. Francis. X. Govers, "Artificial Intelligence for Robotics", Packt Publishing, 2018.
4. Huimin Lu, Xing Lu, "Artificial Intelligence and Robotics", Springer, 2017.
5. Michael Brady, Gerhardt, Davidson, "Robotics and Artificial Intelligence", Springer, 2012.

WEB RESOURCES:

1. https://www.simplilearn.com/tutorials/artificial-intelligencetutorial/what-is-artificial-intelligence1

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ge20
2. https://onlinecourses.nptel.ac.in/noc20_de11

OUTCOMES:

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

1. Apply the concepts of intelligent agents and AI fundamentals in robotic systems. (K3)
2. Apply search, knowledge representation, and logical reasoning techniques to solve AI problems. (K3)
3. Apply state space and logic-based planning methods for intelligent decision-making systems. (K3)
4. Apply probabilistic reasoning and prediction techniques for uncertainty handling in AI systems. (K3)
5. Apply machine learning and reinforcement learning methods for perception and intelligent actions. (K3)
6. Apply AI techniques for robotic perception, localization, mapping, and motion control. (K3)

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MUEL503	AUTOMATION PRINCIPLES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 110105155	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9, 11, 12				
PRE-REQUISITE COURSES	24MUPW302					

OBJECTIVES:

- To understand the basics of automation and control.
- To introduce the automation systems, components and its functions.
- To classify the different automation strategies
- To understand the process control in industries
- To introduce the hardware components of industrial automation.
- To understand the applications of automation.

MODULE - I AUTOMATION SYSTEM **8**

Introduction – physical processes – Localized and distributed processes – Process Behaviour – Process management – Process signals – Automation steps – Automation system structure – Automation sub systems – Needs and Benefits of automation.

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MODULE - II INSTRUMENTATION SUBSYSTEM 7

Structure - Signal interfacing standards – Input instrumentation subsystem – Input data reliability enhancement – Isolation and protection – Output instrumentation subsystem – Human interface subsystem – operator panel – construction – Control subsystem – Interfacing.

MODULE - III AUTOMATION STRATEGIES 8

Basic strategies – Discrete process control – continuous process control – Hybrid process control – Advanced strategies - continuous control – Feed forward control – Cascade control – Ratio control – Multiple step control.

MODULE - IV INDUSTRIAL AUTOMATION 7

Industrial control system – Automation and process control – Purpose of Industrial automation – Industrial automation circuits – Computer based industrial control and automation.

MODULE - V HARDWARE COMPONENTS FOR AUTOMATION AND PROCESS CONTROL 8

Actuators – Types - Electric, Pneumatic and solenoid linear – Relays – Types – Power, General purpose, latching, pulse bistable and solid state – Electric contact classification – Sensors – Types – Timers – Drum switches – special components.

MODULE - VI APPLIED AUTOMATION 7

Building Automation - Home Automation - Systems Design & Operation - Automated HVAC systems - Production Automation - Business Automation - Waste Management Automation - Highway System Automation.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Stamatios Manesis and George Nikolakopoulos, "Introduction to industrial automation", Taylor & Francis Group, 2018.
2. Dey, Chanchal, and Sunit Kumar Sen, Industrial automation technologies, 2020, CRC Press.

REFERENCE BOOKS

1. B.R. Mehta and Y. Jaganmohan Reddy, "Industrial Process Automation Systems: Design and Implementation", Elsevier Inc., 2015.

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2. David W. Pessen, "Industrial Automation: Circuit Design and Components", John Wiley & Sons, Inc, 1989.
3. Mikell P Groover, Automation, Production Systems and Computer Integrated Manufacturing, 2016, Pearson
4. A. K. Gupta and S. K. Arora, "Industrial Automation and Robotics", University science press, 2013.
5. Frank Lamb, "Industrial Automation: Hands On", McGraw hill Education, 2013.

WEB RESOURCES:

1. https://www.harwin.com/blog/the-4-fundamentals-of-industrial-automation.
2. https://fiveable.me/introduction-industrial-engineering/unit-14/fundamentals-industrial-automation.
3. https://understandautomation.com.
4. https://emtmeta.com/the-10-principles-of-automation/
5. https://exactpro.com/sites/default/files/attachments/test_automation_principles.pdf

ONLINE RESOURCES:

1. https://amatrol.com/product/principles-factory-automation/
2. https://www.coursera.org
3. https://www.edx.org
4. https://ocw.mit.edu
5. https://onlinecourses.nptel.ac.in/noc21_me67/preview
6. https://onlinecourses.nptel.ac.in/noc26_ee47/preview
7. https://nptel.ac.in/courses/108105088

OUTCOMES:

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

1. Identify the key aspects and importance of process control in industrial automation. (K3)
2. Develop major control components to automate key processes and activities. (K3)
3. Apply the different methods and strategies used in Industrial Automation for efficient system design and control (K3).

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4. Identify an efficient design of process control loops for process engineering plants. (K3)
5. Identify the different methods of components used in industrial automation. (K3)
6. Apply the basic concepts and applications of Industrial automation. (K3)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MUEL504	AUTOMOBILE ENGINEERING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 1031077125	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand the basic structure, layout and aerodynamic aspects of automobiles.
- To study IC engine components and modern valve actuation mechanisms.
- To understand engine auxiliary systems and emission control technologies.
- To study power transmission from engine to wheels.
- To understand vehicle control, comfort and safety systems.
- To introduce alternative energy sources and advanced vehicle technologies.

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MODULE - I AUTOMOBILE TYPES, STRUCTURE AND AERODYNAMICS **8**

Types of automobiles – vehicle construction – layouts – chassis, frame and body – unitized and conventional construction – vehicle aerodynamics – air resistance, rolling resistance, gradient resistance and moments.

MODULE - II INTERNAL COMBUSTION ENGINES AND VALVE MECHANISMS **7**

IC engine components – functions and materials – engine layouts – variable valve timing (VVT) – significance and applications.

MODULE - III ENGINE AUXILIARY AND EMISSION CONTROL SYSTEMS **8**

Electronic gasoline injection systems – electronically controlled diesel injection systems (unit injector, rotary distributor, CRDI) – electronic ignition systems (TCI and CDI) – turbochargers (WGT and VGT) – three-way catalytic converter – emission norms (Euro and BS).

MODULE - IV TRANSMISSION AND DRIVELINE SYSTEMS **7**

Clutches – types and construction – manual and automatic gearboxes – gear shift mechanisms – overdrive – transfer box – fluid flywheel and torque converter – propeller shaft – universal and slip joints – differential and rear axle – Hotchkiss and torque tube drives.

MODULE - V STEERING, SUSPENSION AND BRAKING SYSTEMS **7**

Steering geometry – steering gear boxes – power steering – front axle types – suspension systems – pneumatic and hydraulic braking systems – ABS – EBD – traction control systems.

MODULE - VI ALTERNATIVE FUELS AND ADVANCED VEHICLE TECHNOLOGIES **8**

Natural gas, LPG, biodiesel, bioethanol, gasohol and hydrogen – engine modifications – performance, combustion and emission characteristics – electric vehicles – hybrid vehicles – fuel cell vehicles.

TOTAL : 45 PERIODS

TEXT BOOK:

1. R. K. Rajput, Textbook of Automobile Engineering, 3rd Revised Edition, Laxmi Publications, 2023.

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2. R. S. Khurmi and J. K. Gupta, A Textbook of Thermal Engineering, 15th Revised Edition, S. Chand Publishing, 2019.

REFERENCE BOOKS

1. Kirpal Singh, Automobile Engineering, 2nd Revised Edition, Standard Publishers Distributors, 2011.
2. Ganesan, V., Internal Combustion Engines, 4th Edition, McGraw-Hill Education, 2012.
3. Tom Denton, Automobile Electrical and Electronic Systems, 4th Edition, Pearson Education, 2012.
4. J. Y. Wong, Theory of Ground Vehicles, 4th Edition, Wiley, 2008.
5. Domkundwar, A. V. and Domkundwar, A., Internal Combustion Engines, 8th Revised Edition, Dhanpat Rai & Co., 2014.

WEB RESOURCES:

1. https://www.sae.org
2. https://www.learnengineering.org
3. https://www.bosch-mobility.com
4. https://nptel.ac.in/courses/112104033

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112104033
2. https://nptel.ac.in/courses/112104034
3. https://nptel.ac.in/courses/112105123

OUTCOMES:

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

1. Illustrate the influence of vehicle construction and aerodynamic forces on automobile performance. (K3)
2. Demonstrate the operation of IC engine components and variable valve timing mechanisms. (K3)
3. Examine the functioning of engine auxiliary systems and emission control technologies in automobiles. (K3)
4. Utilize transmission and driveline system principles to explain power transfer in vehicles. (K3)
5. Interpret the working of steering, suspension, and braking systems for vehicle control and stability. (K3)

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6. Assess the performance and emission characteristics of alternative fuel and advanced vehicle technologies. (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	3	2	2	1	-	-	-	1	-	-	-	3	2
CO3	3	3	2	1	-	-	-	1	-	-	-	3	3
CO4	3	3	2	1	-	-	-	1	-	-	-	3	3
CO5	3	2	2	1	-	-	-	1	-	-	-	2	2
CO6	2	2	3	1	-	-	-	1	-	-	-	2	3

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MUEL505	AUTOMOTIVE MATERIALS AND MANUFACTURING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112106293	SYLLABUS VERSION 1.0	SDG NO. 4, 7, 9, 12				
PRE-REQUISITE COURSES	24BSPH202					

OBJECTIVES:

- Understand the classification and evolution of engineering materials and interpret their properties using materials selection charts for automotive applications.
- Apply the fundamental principles of material selection, including material indices, design requirements, and attribute limits in engineering design.
- Analyze and select suitable materials for engine and transmission components
- Evaluate appropriate materials for automotive structural components
- Examine electronic and sensor materials used in modern automobiles.

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MODULE - I ENGINEERING MATERIALS AND THEIR PROPERTIES 8

Classes of engineering materials - the evolution of engineering materials, Definition of materials properties, displaying material properties using materials selection charts, Forces for change in materials selection and design, Materials and the environment-selection of materials for automotive applications.

MODULE - II BASIS OF MATERIAL SELECTION 7

Selection strategy, Attribute limits and Material indices, structural index Selection procedure: Design process - types of design, design requirements, Function, Material attributes

MODULE - III MANUFACTURING PROCESSES 8

Shape and Manufacturing processes. Systematic process selection, Energy consumption for production, Material costs, Availability, Recyclability, Environmental consideration. Computer aided selection.

MODULE - IV MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS 7

Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches.

MODULE - V MATERIALS FOR AUTOMOTIVE STRUCTURES 7

Materials selection for bearings, leaf springs, chassis & frames, Bumper, shock absorbers, wind screens, panels, brake shoes, Disc, wheels, differentials, damping and antifriction fluids, Tires and tubes.

MODULE - VI ELECTRONIC MATERIALS FOR AUTOMOTIVE APPLICATIONS 8

Materials for sensors and electronic devices meant for Engine Speed and Crank Position, Throttle position sensor, Manifold Absolute Pressure, Temperature Sensor, Oxygen Sensor, Piezoelectric Sensor, Ultrasonic Sensor and Dew Sensor. Sensor Materials and Technologies.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Gladius Lewis, "Selection of Engineering Materials", Prentice Hall Inc. New Jersey USA, 1995.

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2. Hiroshi Yamagata," The Science and Technology of Materials in Automotive Engines", Woodhead Publishing, 2005

REFERENCE BOOKS

1. ASM Handbook. "Materials Selection and Design", Vol. 20- ASM Metals Park Ohio. USA, 1997.
2. ASM Handbook, "Selection of Materials Vol. 1 and 2", ASM Metals Park, Ohio. USA, 1991.
3. Cantor, "Automotive Engineering: Lightweight, Functional, and Novel Materials", Taylor & Francis Group, London, 2006
4. James A. Jacobs, Thomas F. Kilduff., "Engineering Materials Technology: Structure, Processing, Properties & Selection", Prentice Hall, USA, 1996.
5. M F Ashby, "Materials Selection in Mechanical Design", third edition, Butterworth Heineman, New York, 2005.

WEB RESOURCES:

1. https://www.automotivemanufacturingsolutions.com/
2. https://www.advancedmanufacturing.org/industries/motorized-vehicle/advanced-materials-in-automotive/article_a4de7ce0-cf86-11ef-a8ea-ebe16e47fc4c.html
3. https://www.asminternational.org/
4. https://www.sae.org/
5. https://ieeexplore.ieee.org/

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_me105/preview
2. https://onlinecourses.nptel.ac.in/noc26_me39/preview
3. https://onlinecourses.nptel.ac.in/noc21_de02/preview

OUTCOMES:

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

1. Classify engineering materials based on their properties and automotive application requirements. (K3)
2. Apply material selection strategies and indices to choose suitable materials for engineering designs. (K3)
3. Utilize manufacturing process selection criteria to determine appropriate production methods for engineering components. (K3)

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4. Select suitable materials for engine and transmission components based on functional requirements. (K3)
5. Determine appropriate materials for automotive structural components considering performance and durability. (K3)
6. Examine sensor materials and technologies used in automotive electronic applications. (K3)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MUEL506	SMART MOBILITY AND INTELLIGENT VEHICLES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 109101005	SYLLABUS VERSION 1.0	SDG NO. 4, 7, 9, 12				
PRE-REQUISITE COURSES	24MUPW302					

OBJECTIVES:

- To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
- To learn the Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, and other sensors for automobile vision systems.
- To learn Basic Control System Theory applied to Autonomous Automobiles.

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- To impart knowledge of wireless networking, vehicle communication systems, IoT integration, and on-board automotive network technologies.
- To enable students to analyze connected car and autonomous vehicle technologies along with their applications, challenges, security concerns, and societal impacts.

MODULE - I INTRODUCTION TO AUTOMATED CONNECTED AND INTELLIGENT VEHICLES **8**

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles.

MODULE - II SENSOR TECHNOLOGY FOR SMART MOBILITY **7**

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems.

MODULE - III CONNECTED AUTONOMOUS VEHICLE **8**

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy.

MODULE - IV VEHICLE WIRELESS TECHNOLOGY **7**

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modula ion/ Encoding, Receiver System Concepts – Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy

MODULE - V NETWORKING **7**

Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks.

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MODULE - VI CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY **8**

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", Springer, 2019.
2. James D. Halderman, Automotive Technology: Principles, Diagnosis, and Service, 6th Edition, Automotive Technology: Principles, Diagnosis, and Service, Pearson Education, 2022.

REFERENCE BOOKS

1. Tom Denton, "Automobile Electrical and Electronic systems, Roult edge", Taylor & Francis Group, 5th Edition, 2018.
2. Turban E., "Decision Support and Export Systems Management Support Systems", Maxwell Macmillan, 1998.
3. Sitausu S. Mittra, "Decision Support Systems – Tools and Techniques", John Wiley, New York, 1986.
4. Papacostas C.S., Prevedouros, "Transportation Engineering and Planning", 3rd Edition, Prentice Hall of India, New Delhi, 2002.
5. Intelligent Transportation Systems and Connected and Automated Vehicles, 2016, Transportation Research Board.

WEB RESOURCES:

1. https://www.udemy.com/course/cooperative-intelligent-transportation-systems-cits-its/
2. https://ieee-itss.org/courses/introduction-to-intelligent-transportation
3. https://www.qualcomm.com/
4. https://www.transportation.gov/
5. https://ieeexplore.ieee.org/

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ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105107210
2. https://nptel.ac.in/courses/105105204

OUTCOMES:

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

1. Illustrate the functions of automotive electronics in automated, connected, and intelligent vehicles. (K3)
2. Utilize sensor technologies and data fusion techniques for smart mobility applications. (K3)
3. Apply cyber-physical system and control concepts to connected autonomous vehicle operations. (K3)
4. Demonstrate wireless communication principles used in vehicle autonomy and connectivity. (K3)
5. Integrate wireless networking concepts with on-board vehicle networks for connected vehicle applications. (K3)
6. Examine connected car and autonomous vehicle technologies for intelligent transportation systems. (K3)

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEEL504	NON DESTRUCTIVE TESTING AND EVALUATION	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 113106070	SYLLABUS VERSION 1.0	SDG NO. 3, 8, 9, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To learn different surface inspection techniques.
- To provide knowledge on sub surface testing methods.
- To impart knowledge on ultrasonic testing method.
- To provide knowledge on radiography testing method.
- To study various special non-destructive testing methods.

MODULE - I INTRODUCTION TO NDT AND VISUAL TESTING 7

Introduction and Scope of NDT, Discontinuities and Defects in various manufactured Components, Various physical characteristics of materials and their applications in NDT, Relative merits and limitations of NDT, Types of NDT techniques, Visual or Optical Testing - Direct and remote visual inspection and Aides

MODULE - II LIQUID PENETRANT TESTING (LPT) 7

Liquid Penetrant Testing (LPT) Principles - Types and properties of liquid penetrants and developers - Preparation of test materials - Advantages and limitations - Application of penetrants to parts - Fluorescent penetrant test.

MODULE - III SUB SURFACE TECHNIQUES TESTING 7

Magnetic Particle Testing (MPT) - Principles, applications, magnetization methods, magnetic particles - Dry particle technique and Wet fluorescent particle technique - Advantages and Limitations. Eddy Current Inspection - Principle, Methods, Equipment for ECT, Techniques, Sensitivity, Application, scope and limitations.

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MODULE - IV ULTRASONIC TESTING **8**

Ultrasonic Testing (UT) - Principle, Types and characteristics of Ultrasonic waves - Attenuation, Couplants, Probes - Inspection methods - Pulse echo, Transmission and Phased Array techniques (PAUT), Types of scanning and displays - Angle beam inspection of welds - Calibration of ASTM Test blocks, International Institute of Welding IIW) reference blocks – Applications

MODULE - V RADIOGRAPHY TESTING **8**

Radiographic testing (RT) -Principle, Sources of X-rays and Gamma rays and their characteristics - Absorption, scattering, Filters and screens, imaging modalities - Film radiography and Digital Radiography - Problems in shadow formation, Exposure factors, film handling and storage- Inverse square law, Exposure charts, and Radiographic equivalence, Penetrometers - Safety in radiography Applications.

MODULE - VI SPECIAL NDT TECHNIQUES **8**

Acoustic Emission Testing (AET) Principle - Instrumentation and applications, advantages and limitations. Infra-Red Thermography (IRT) - Principle, Techniques and applications. Leak Testing - Principle, Testing Procedure and applications. LASER Stereography- Typical applications, Requirements - advantages and disadvantages.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Charles J. Hellier, Handbook Of Nondestructive Evaluation, McGraw-Hill Education; 2nd edition 2012.
2. Baldev Raj, Jayakumar T, Thavasimuthu M, Practical Non-Destructive Testing, Narosa Publishing, 2009.
3. J Prasad, GCK Nair , "Non destructive test and evaluation of Materials", Tata McGraw Hill Education Publishers, 2008.
4. Josef Krautkrämer, Herbert Krautkrämer, "Ultrasonic testing of materials", 3rd edition, Springer-Verlag, 1983.
5. X. P. V. Maldague, "Non destructive evaluation of materials by infrared thermography", 1 st edition, Springer-Verlag, 1993.

REFERENCES:

1. Gary L. Workman, Patrick O. Moore, Doron Kishoni, "Non-destructive, Hand Book, Ultrasonic Testing", 3rd edition, Amer Society for Nondestructive, 2007.

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2. Mc Gonnagle W T, Non-Destructive Testing, McGraw Hill Book Co., 1988.
3. Louis Cartz, Non-Destructive Testing, ASM International, Metals Park Ohio, US, 1995
4. ASTM Standards, Vol 3.01, Metals and alloys
5. ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 2001.

WEB REFERENCES:

1. https://nptel.ac.in/courses/113/106/113106070/
2. https://nptel.ac.in/courses/108105088
3. https://nptel.ac.in/courses/112/107/112107259/

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc19_mm07/course
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mm44

OUTCOMES:

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

1. Select appropriate non-destructive testing techniques and visual inspection methods based on material characteristics, defects, and inspection requirements.. (K3)
2. Perform mechanical testing of metals using relevant Indian standards and destructive testing methods.. (K3)
3. Interpret results of tensile, hardness, and impact tests for material evaluation. (K3)
4. Choose suitable design parameters and standards for continuous bulk conveying systems. (K3)
5. Implement maintenance practices and operational procedures in conveying systems. (K3)
6. Examine rolling bearing performance and identify wear patterns and failure modes through testing and analysis. (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	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO4	2	2	2	2	-	-	-	-	-	-	-	2	2
CO5	2	2	2	2	-	-	-	-	-	-	-	2	2
CO6	3	3	3	2	-	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEEL505	MATERIAL JOINING TECHNIQUES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112107213	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand the fundamentals and classifications of material joining processes.
- To acquire knowledge of fusion, resistance, solid-state and advanced joining technologies.
- To select appropriate joining processes for various engineering materials and industrial applications.
- To evaluate weld quality, weld ability and inspection techniques for reliable fabrication

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MODULE - I FUNDAMENTALS OF METAL JOINING TECHNOLOGIES 8

Introduction to material joining and its industrial significance – Classification of joining processes – Mechanisms of metallic continuity: fusion, plastic deformation, diffusion and chemical interaction – Joint configurations and weld nomenclature – Selection criteria for joining processes – Heat sources used in joining technologies – Advantages and limitations of various joining methods

MODULE - II FUSION WELDING PROCESSES 8

Gas welding and oxy-fuel welding – Arc welding principles – Shielded Metal Arc Welding (SMAW) – Gas Metal Arc Welding (GMAW/MIG) – Gas Tungsten Arc Welding (GTAW/TIG) – Submerged Arc Welding (SAW) – Plasma Arc Welding (PAW) – Electroslag Welding (ESW) – Welding consumables – Process variables and industrial applications.

MODULE - III RESISTANCE AND SOLID-STATE JOINING PROCESSES 7

Fundamentals of resistance welding – Spot welding – Seam welding – Projection welding – Flash butt welding – Friction welding – Friction Stir Welding (FSW) – Diffusion bonding – Ultrasonic welding – Roll bonding – Cold welding – Applications and process limitations..

MODULE - IV ADVANCED AND SPECIAL JOINING PROCESSES 7

Laser Beam Welding (LBW) – Electron Beam Welding (EBW) – Explosive welding – Thermit welding – Underwater welding – Hybrid welding processes – Micro joining and nano joining concepts – Industrial applications in aerospace, automobile and power sectors.

MODULE - V BRAZING, SOLDERING AND ADHESIVE BONDING 7

Principles of brazing – Brazing filler metals and fluxes – Brazing processes – Fundamentals of soldering – Soft and hard soldering – Adhesive bonding mechanisms – Surface preparation techniques – Design considerations – Industrial applications of brazing, soldering and adhesive bonding.

MODULE - VI WELDING METALLURGY, QUALITY CONTROL AND WELDABILITY 8

Solidification of weld metal – Heat Affected Zone (HAZ) – Phase transformations in weldments – Residual stresses and distortion – Welding defects: cracks, porosity, inclusions and lack of fusion – Destructive and Non-

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Destructive Testing (NDT) – Weldability of steels, stainless steels, aluminium alloys and non-ferrous alloys – Quality assurance in welded structures.

TOTAL : 45 PERIODS

TEXT BOOK:

1. D.K. Dwivedi, Joining Technologies for Metals, NPTEL Course Material, IIT Roorkee.
2. Parmer R.S., Welding Engineering and Technology, 1st Edition, Khanna Publishers, New Delhi, 2008.
3. Parmer R.S., Welding Processes and Technology, Khanna Publishers, New Delhi, 1992.

REFERENCES:

1. Nadkarni S.V., Modern Arc Welding Technology, Oxford IBH Publishers, 2005.
2. Schwartz M.M., Metals Joining Manual, McGraw-Hill Publications.
3. Cary H.B. and Helzer S.C., Modern Welding Technology, Pearson Education.
4. Kou S., Welding Metallurgy, Wiley-Interscience Publications.
5. Tylecote R.F., The Solid Phase Welding of Metals, Edward Arnold Publishers Ltd., London.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112107213

ONLINE RESOURCES:

2. https://nptel.ac.in/courses/112107213
3. https://nptel.ac.in/courses/112103244
4. https://www.awslearning.org/pages/aws-resources
5. https://theweldinginstitute.com/

OUTCOMES:

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

1. Interpret and explain the fundamentals, classifications and selection criteria of metal joining processes (K3).
2. Demonstrate knowledge of fusion welding processes and their industrial applications (K3).

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3. Examine resistance and solid-state joining techniques for engineering applications (K4).
4. Evaluate advanced and special joining processes used in modern manufacturing industries (K4).
5. Select suitable brazing, soldering and adhesive bonding techniques for specific engineering requirements (K4).
6. Assess weld quality, weldability and inspection methods for welded structures (K4).

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEEL506	CNC MACHINE TOOLS AND PROGRAMMING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112106139	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11, 12, 13				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To introduce the evolution, types and principles of CNC machine tools
- To familiarize the students with constructional features of CNC machine tools
- To acquaint the students with various drives and axis measuring systems used in CNC machine tools

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- To gain knowledge on manual part program and generation of CNC part program using CAM packages
- To familiarize the students with various tooling and work holding devices used in CNC machine tools

MODULE - I INTRODUCTION TO CNC MACHINE TOOLS **7**

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection.

MODULE - II STRUCTURE OF CNC MACHINE TOOL **7**

CNC Machine building - structural details - configuration and design - guide ways – Friction, Anti friction and other types of guide ways - elements used to convert the rotary motion to a linear motion - Screw and nut - recirculating ball screw - spindle assembly - torque transmission elements - gears - timing belts - flexible couplings - Bearings.

MODULE - III DRIVES AND CONTROLS **7**

Spindle drives - feed drives - stepper motor - servo motor - linear motor - Axis measuring system - open loop and closed loop control - synchro - synchro resolver- gratings- moiré fringe gratings, encoders - inductosyn - laser interferometer.

MODULE - IV CNC PROGRAMMING **8**

Coordinate system - structure of a CNC part program - G & M Codes - tool length compensation - cutter radius and tool nose radius compensation - mirror image - canned cycles- programming for machining centre and turning centre for well known controllers - generation of CNC codes from CAM packages.

MODULE - V TOOLING AND WORK HOLDING DEVICES **8**

Cutting tool materials for CNC machine tools- hard metal insert tooling- inserts and tool holder classification - qualified - semi qualified and preset tooling - ATC - APC - tooling for machining and turning centre - silent tool - work holding devices for rotating and fixed work parts- use of probes in CNC machines - economics of CNC - maintenance of CNC machines.

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MODULE - VI COMPUTER AIDED PART PROGRAMMING 8

Need for computer aided part programming, Tools for computer aided part programming, APT, CAD/CAM based part programming for well-known controllers such as Fanuc, Heidenhain, Sinumerik etc., and generation of CNC codes from CAM packages.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education 8th Edition, 2022.
2. 2. Michael Fitzpatrick, "Machining and CNC Technology", McGraw-Hill Education;4th edition, 2019.

REFERENCES:

1. CNC Machining Hand Book James Madison Industrial Press Inc 1996
2. Programming of CNC Machines Ken Evans, John Polywka& Stanley Gabrel Industrial Press Inc, New York Second Edition2002
3. CNC Programming Hand book Peter Smid Industrial Press Inc 2000
4. Pabla E S & Adithan M. "CNC Machines", New Age publishers, New Delhi.
5. Pollack Herman W. & Robinson T., "Computer Numerical Control", Prentice Hall NJ.
6. Seams Warren "Computer Numerical Control: Concepts, Programming", Delmar Publisher Inc. New York
7. Evans K., Polywka J. and Stanley Gabrel. "Programming of CNC Machines", 4thEdition, Industrial Press Inc., New York, 2016, ISBN: 9780831135249.
8. Radhakrishnan P., "Computer Numerical Control Machines and Computer Aided Manufacturing", New Age International Publishers., United States, 2018, ISBN-13: 978- 8122433975.
9. Rao P.N., "CAD/CAM Principles and Applications", 3rd Edition, Tata McGraw, Hill Publishing Company Limited, New Delhi, 2010, ISBN-13: 978-0070681934. 5. Smid P., "CNC Programming Hand book", 3rd Edition, Industrial Press Inc., United States, 2008, ISBN-13: 978-0831133474.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112102103
2. https://www.siemens.com/en-us/industries/industrial-machinery/machine-tools/cnc4you/
3. https://www.fanucamerica.com/

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4. https://www.mastercam.com/
5. https://www.cimco.com/documentation/online/cncbook/en/#frontpage

ONLINE RESOURCES:

1. https://www.coursera.org/learn/introduction-cad-cam-practical-cncmachining.
2. https://nptel.ac.in/courses/112105211
3. https://nptel.ac.in/courses/112/106/112106138/
4. https://nptel.ac.in/courses/112/106/112106179/
5. https://nptel.ac.in/courses/112/104/112104250/
6. https://nptel.ac.in/courses/112/103/112103261/
7. https://nptel.ac.in/courses/112/106/112106140/
8. https://nptel.ac.in/courses/112/107/112107242/
9. https://nptel.ac.in/courses/112/107/112107259/

OUTCOMES:

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

1. Analyze the evolution, classification, principles, and applications of CNC machine tools. (K4)
2. Examine the constructional features and standard components of CNC machine tools for enhanced machining accuracy and productivity. (K4)
3. Select appropriate drive systems, control systems, and position feedback devices for CNC machine tools. (K3)
4. Develop CNC part programs for two-axis turning centers and three-axis machining centers using standard G and M codes. (K3)
5. Generate and validate CNC part programs for popular CNC controllers using manual programming and CAD/CAM software packages. (K3)
6. Evaluate suitable cutting tools, tooling systems, and work-holding devices for various CNC machining 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	-
CO2	3	3	-	-	2	-	-	-	-	-	-	2	-
CO3	3	2	2	-	3	-	-	-	-	-	-	3	-
CO4	2	2	3	-	3	-	-	-	-	-	-	3	2
CO5	2	2	3	-	3	-	-	-	-	-	-	3	3
CO6	3	3	2	-	2	-	-	-	-	-	-	3	-

PROFESSIONAL ELECTIVE - I

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, 24BSPH202					

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.

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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.

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

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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.

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)

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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)

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

PROFESSIONAL ELECTIVE - I

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	-					

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.

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- 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.

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

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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.

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

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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]

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	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	-

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Electrical and Electronics Engineering

PROFESSIONAL ELECTIVE - I

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	-					

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).

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.

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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.

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

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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
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/

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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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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MUEL507	ROBOT OPERATION SYSTEM	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 107106090	SYLLABUS VERSION 1.0	SDG NO.: 4,9,11,12				
PRE-REQUISITE COURSES	24MUPC403					

OBJECTIVES:

- To introduce the basics of Robot Operating Systems and its architecture.
- To provide knowledge on the hardware interfacing aspects.
- To understand the applications of ROS in real world complex applications.
- To perform debugging of nodes and file launching
- To analyze the computational parameters of RoS.
- To visualize the RoS parameters.

MODULE - I INTRODUCTION 7

Introduction – ROS Equation - History - distributions -difference from other meta-operating systems services - ROS framework – operating system – releases. UNIX commands - file system – redirection of input and output - File system security - Changing access rights – process commands – compiling, building and running commands – handling variables.

MODULE - II ARCHITECTURE OF OPERATING SYSTEM 8

File system - packages – stacks – messages – services – catkin workspace – working with catkin workspace – working with ROS navigation and listing commands.

MODULE - III COMPUTATION GRAPH LEVEL 8

Navigation through file system -Understanding of Nodes – topics – services – messages – bags – master – parameter server.

MODULE - IV DEBUGGING AND VISUALIZATION 8

Debugging of Nodes – topics – services – messages – bags – master – parameter – visualization using Gazebo – Rviz – URDF modeling – Xacro – launch files.

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MODULE - V CASE STUDIES: USING ROS IN REAL WORLD APPLICATIONS **7**

Navigation stack-creating transforms -odometer – IMU – laser scan – base controller – robot configuration – cost map – base local planner – global planner – localization – sending goal– the low cost mobile robot.

MODULE - VI HARDWARE INTERFACES **7**

Hardware Interface: Sensor Interfacing – Sensor Drivers for ROS – Actuator Interfacing – Motor Drivers for ROS.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Lentin Joseph, "Robot Operating Systems (ROS) for Absolute Beginners, Apress, 2018
2. Aaron Martinez, Enrique Fernandez, "Learning ROS for Robotics Programming", Packt Publishing Ltd, 2013

REFERENCE BOOKS

1. Jason M O'Kane, "A Gentle Introduction to ROS", Create Space, 2013.
2. Anis Koubaa, "Robot Operating System (ROS) – The Complete Reference (Vol.3), Springer, 2018.
3. Kumar Bipin, "Robot Operating System Cookbook", Packt Publishing, 2018.
4. Wyatt Newman, "A Systematic Approach to learning Robot Programming with ROS", CRC Press, 2017.
5. Patrick Gabriel, "ROS by Example: A do it yourself guide to Robot Operating System", Lulu, 2012.

WEB RESOURCES:

1. http://robotics.stanford.edu/~ang/papers/icraoss09-ROS.pdf
2. https://stanfordasl.github.io/aa274a/pdfs/notes/lecture2.pdf
3. http://wiki.iranros.com/wp-content/uploads/2019/10/Lentin-Joseph-Robot-Operating-SystemROSfor-Absolute-Beginners_IRANROS.COM2018.pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112105236
2. https://nptel.ac.in/courses/112105249

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3. https://nptel.ac.in/courses/112103280
4. https://nptel.ac.in/courses/107106090
5. https://nptel.ac.in/courses/106105217
6. https://nptel.ac.in/courses/112101304
7. https://nptel.ac.in/courses/112106304

OUTCOMES:

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

1. Identify the need for ROS and Linux commands used in robotics. (K3)
2. Develop the concepts behind navigation through file system. (K3)
3. Organize the concepts of concepts of Node debugging. (K3)
4. Solve the issues in hardware interfacing. (K3)
5. Apply ROS in various applications. (K3)
6. Identify and build the hardware interfaces of RoS (K3)

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL501	INDUSTRIAL ROBOT THEORY AND IMPLEMENTATION	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112105319	SYLLABUS VERSION 1.0	SDG NO. 3,9,11,12				
PRE-REQUISITE COURSES	24MUPC403					

OBJECTIVES:

- Understand the fundamental concepts, structure, and classification of industrial robots.
- Study the kinematics and dynamics of robot manipulators used in industrial applications.
- Learn the actuation systems, sensors, and control techniques used in robotic systems.
- Understand robot programming methods and robot control strategies.
- Analyze end effectors, grippers, and robot tooling systems used in automation.
- Explore applications of industrial robots in manufacturing and automated production systems.

MODULE - I INTRODUCTION TO INDUSTRIAL ROBOTS 7

Definition and classification of robots – Robot anatomy – Degrees of freedom – Robot configurations – Robot components – Robot joints and links – Robot coordinate systems – Robot specifications – Applications of industrial robots.

MODULE - II ROBOT KINEMATICS 8

Forward kinematics – Inverse kinematics – Homogeneous transformation matrices – Denavit-Hartenberg representation – Position and orientation of robot end effector – Workspace analysis.

MODULE - III ROBOT DYNAMICS 8

Robot dynamics – Forces and torques in manipulators – Newton-Euler formulation – Lagrange formulation – Dynamic analysis of robot manipulators – Trajectory planning.

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MODULE - IV ROBOT DRIVES AND SENSORS **7**

Robot actuators – Hydraulic drives – Pneumatic drives – Electric drives – Servo motors – Stepper motors – Sensors in robotics – Position sensors – Force and torque sensors – Vision sensors.

MODULE - V ROBOT PROGRAMMING **7**

Robot programming methods – Lead-through programming – Offline programming – Robot programming languages – VAL, AML – End effectors – Grippers – Tooling and work holding devices.

MODULE - VI INDUSTRIAL ROBOT APPLICATIONS **8**

Robot applications in manufacturing – Material handling – Assembly operations – Welding – Painting – Inspection – Flexible manufacturing systems – Safety considerations in robot operations.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Mikell P. Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi, India, 2008.
2. Saeed B. Niku, "Introduction to Robotics: Analysis, Control and Applications", John Wiley & Sons, New York, USA, 2001.

REFERENCE BOOKS

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, "Industrial Robotics: Technology, Programming and Applications", McGraw Hill, New York, USA, 2000.
2. John J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson Education, Upper Saddle River, USA, 2005.
3. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering: An Integrated Approach", Prentice Hall, New Jersey, USA, 1989.
4. Bruno Siciliano and Oussama Khatib, "Springer Handbook of Robotics", Springer, Berlin, Germany, 2008.
5. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, New York, USA, 1987.

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WEB RESOURCES:

1. https://www.ifr.org/
2. https://www.robotics.org/
3. https://www.universal-robots.com/blog/
4. https://www.ros.org/
5. https://www.roboticsbusinessreview.com/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112105319
2. https://onlinecourses.nptel.ac.in/noc23_me143/preview
3. https://nptel.ac.in/courses/112103174
4. https://onlinecourses.nptel.ac.in/noc22_me50/preview

OUTCOMES:

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

1. Apply the fundamental concepts, classification, and components of industrial robots to identify appropriate robot configurations. (K3)
2. Identify the kinematic principles to determine the motion of robot manipulators in industrial systems. (K3)
3. Apply the principles of robot actuators, drives, and sensors to solve basic problems in robotic systems. (K3)
4. Implement robot programming methods and control techniques to execute basic robotic operations. (K3)
5. Select suitable robot end effectors and grippers for specific industrial applications. (K3)
6. Apply industrial robot concepts to solve problems in manufacturing and automation systems. (K3)

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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	1
CO2	3	2	1	–	–	–	–	–	–	–	–	3	2
CO3	3	2	1	–	1	–	–	–	–	–	–	3	3
CO4	2	2	1	–	1	–	–	–	–	–	–	3	3
CO5	2	2	1	–	–	–	–	–	–	–	–	2	2
CO6	2	3	2	1	1	–	–	–	–	–	–	2	3

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MUEL509	AUTOMATION IN PROCESS INDUSTRIES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108105062	SYLLABUS VERSION 1.0	SDG NO. 8,11,12				
PRE-REQUISITE COURSES	24MUPW401					

OBJECTIVES:

- Provide knowledge of the design and application of signal conditioning circuits used in industrial measurement and control systems.
- Introduce various signal transmission techniques and their design principles for reliable data communication.
- Develop an understanding of the components and interfacing methods employed in data acquisition systems.
- Familiarize students with the architecture and key components of Distributed Control Systems (DCS).
- Impart knowledge of industrial communication buses and networking technologies used in automation and control industries

MODULE - I INTRODUCTION 7

Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: Modbus & Profibus

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MODULE - II AUTOMATION COMPONENTS **8**

Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

MODULE - III COMPUTER AIDED MEASUREMENT SYSTEMS **8**

Role of computers in measurement and control – Elements of computer aided measurement and control – Man–machine interface – Computer aided process control hardware – Process related interfaces.

MODULE - IV COMPUTER AIDED PROCESS CONTROL AND IoT **7**

Communication and networking – Industrial communication systems – Data transfer techniques – Computer aided process control software – Computer based data acquisition system – Internet of Things (IoT) for plant automation.

MODULE - V PLC AND SCADA **7**

Programmable logic controllers - Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries. SCADA - Architecture - Elements, block diagram of SCADA: Types of SCADA, MTU and RTU functions.

MODULE - VI DISTRIBUTED CONTROL SYSTEM **8**

Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL : 45 PERIODS

TEXT BOOK:

1. John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall Inc., 2003.
2. Politeknik Port Dickson, Industrial Automation: An Engineering Approach, Politeknik Port Dickson Publication, 2013.

REFERENCE BOOKS

1. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016.

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2. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011.
3. Gary Dunning, Thomson Delmar, "Programmable Logic Controller", Ceneage Learning, 3 rd Edition,2005.
4. Viswanandham N & Narahari Y, Performance Modeling of Automated Manufacturing Systems, PHI, 1st Edition, 2009.
5. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 3rd Edition, Pearson Education, New Delhi, 2015.

WEB RESOURCES:

1. https://nikarifblog.files.wordpress.com/2017/12/jm608-industriial-automation-textbook.pdf
2. https://industlabs.com/news/industrial-automation
3. https://www.machinemetrics.com/blog/industrial-automation
4. https://nptel.ac.in/content/storage2/courses/108105063/pdf/L01(SM)(IA&C)%20((EE)NPTEL).pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108105088
2. https://nptel.ac.in/courses/108105062
3. https://nptel.ac.in/courses/108105063

OUTCOMES:

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

1. Apply the concepts of industrial automation to identify suitable automation solutions. (K3)
2. Select appropriate sensors and actuators for measurement and motion control applications. (K3)
3. Implement computer-aided measurement systems by utilizing process interfaces and man–machine interaction techniques. (K3)
4. Apply communication, networking, and IoT concepts to develop computer-aided process control and data acquisition systems. (K3)
5. Execute PLC programming, configuration, and SCADA operations for industrial process control applications. (K3)
6. Utilize distributed control system (DCS) concepts to integrate, configure, and manage industrial automation systems. (K3)

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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	1
CO2	3	2	1	–	1	–	–	–	–	–	–	3	2
CO3	3	2	1	–	1	–	–	–	–	–	–	3	3
CO4	2	2	1	–	1	–	–	–	–	–	–	3	3
CO5	2	3	2	1	1	–	–	–	–	–	–	2	2
CO6	2	3	2	1	1	–	–	–	–	–	–	2	3

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MUEL510	ELECTRIC AND HYBRID VEHICLES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108103009	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 12, 15				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand the need, architecture, and design considerations of electric and hybrid vehicles.
- To analyze various energy storage systems used in EVs and HEVs.
- To study electric motors, drives, and control strategies used in EV applications.
- To understand power electronic converters and switching devices in traction systems.
- To examine hybrid vehicle configurations and control strategies.
- To evaluate performance, economy, and case studies of modern EVs and HEVs.

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MODULE - I FUNDAMENTALS AND DESIGN CONSIDERATIONS OF ELECTRIC VEHICLES **8**

Need for Electric Vehicles - Comparative study: Petrol, Diesel, Hybrid & Electric Vehicles - Advantages and Limitations of Hybrid & EVs - Design requirements: Range, Maximum velocity, Acceleration, Power requirement, Vehicle mass - Various Resistances (Rolling, Gradient, Aerodynamic) - Transmission efficiency - EV Chassis and Body Design - EV Recharging and Refueling Systems.

MODULE - II ENERGY STORAGE SYSTEMS FOR ELECTRIC VEHICLES **8**

Battery Parameters (SOC, SOH, C-rate, Energy Density) - Types of Batteries: Lead Acid,

Nickel Metal Hydride, Lithium-ion, Sodium-based, Metal-Air. Battery Modelling and Equivalent Circuits - Battery Charging Methods & Quick Charging - Ultra Capacitors - Battery Management System (BMS).

MODULE - III FUEL CELLS AND ADVANCED ENERGY SYSTEMS **7**

Fuel Cell Fundamentals - Fuel Cell Characteristics - Fuel Cell Types (PEMFC, SOFC, AFC, etc.) - Half Reactions of Hydrogen Fuel Cell - Fuel Cell Applications in EVs - Integration with Hybrid Systems.

MODULE - IV HEV ARCHITECTURE AND VEHICLE DYNAMICS **7**

HEV architectures – series, parallel and series-parallel – micro and mild hybrids – HEVs in hilly terrains – electric cars and heavy-duty EVs – roadway fundamentals – vehicle dynamics – drive cycles – tire–road interaction – tractive force, power and energy.

MODULE - V EV AND HEV POWERTRAIN COMPONENTS AND BRAKING SYSTEMS **7**

Powertrain component sizing – motors, gears, clutches, differential and transmission – EV powertrain sizing – HEV powertrain sizing – regenerative and conventional braking systems – numerical examples.

MODULE - VI PLUG-IN HYBRID ELECTRIC VEHICLES **8**

Introduction and history of PHEVs – comparison with EVs and HEVs – construction and working – block diagram and components – charging mechanisms – advantages and applications of PHEVs.

TOTAL : 45 PERIODS

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TEXT BOOK:

1. Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles, 3rd Revised Edition, CRC Press, 2018.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd Revised Edition, CRC Press, 2011.

REFERENCE BOOKS

1. Sheldon S. Williamson, Suresh G. Advani and Ali Emadi, Energy Management and Control of Hybrid Electric Vehicles, 2nd Revised Edition, Springer Nature, 2022.
2. John G. Hayes and G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, 1st Edition, Wiley, 2018.
3. James Larminie and John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley, 2012.
4. Chris Mi, M. Abul Masrur and David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, 2nd Edition, Wiley, 2011.
5. J. Y. Wong, Theory of Ground Vehicles, 4th Edition, Wiley, 2008.

WEB RESOURCES:

1. https://afdc.energy.gov/vehicles/electric.html
2. https://www.iea.org/reports/global-ev-outlook
3. https://batteryuniversity.com
4. https://nptel.ac.in/courses/108101004
5. https://nptel.ac.in/courses/108105066

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108106186
2. https://nptel.ac.in/courses/108108078
3. https://nptel.ac.in/courses/108105180
4. https://nptel.ac.in/courses/108106170
5. https://nptel.ac.in/courses/108105159

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OUTCOMES:

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

1. Identify the influence of EV design parameters on electric vehicle performance. (K3)
2. Develop the charging characteristics of electric vehicles and the operation of fast charging systems. (K3)
3. Organize the features and performance characteristics of Electric Vehicles and Hybrid Electric Vehicles. (K3)
4. Construct the different HEV architectures and explain vehicle dynamic behavior under various driving conditions. (K3)
5. Apply basic sizing methods to determine the specifications of EV and HEV powertrain components. (K3)
6. Build the architecture, operating modes, and charging strategies of Plug-in Hybrid Electric Vehicles (PHEVs). (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	2	1	-	-	-	-	-	-	-	2	1
CO3	3	3	2	1	-	-	-	-	-	-	-	2	2
CO4	3	3	2	1	-	-	-	-	-	-	-	2	2
CO5	3	2	2	1	-	-	-	-	-	-	-	1	2
CO6	2	2	3	1	-	-	-	-	-	-	-	1	1

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MUEL511	ENERGY STORAGE AND ELECTRIC MOBILITY SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 113105102	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 12, 15				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand the fundamentals, characteristics and modeling of battery energy storage systems.
- To study non-battery and hybrid energy storage technologies.
- To understand the evolution of electric and hybrid electric vehicles.
- To Understand energy storage integration and vehicle performance parameters in EVs.
- To Study EV powertrain components and energy recovery methods.
- To Understand advanced energy storage technologies and PHEV systems.

MODULE - I ELECTRICAL ENERGY STORAGE SYSTEMS 8

Fundamental concepts of batteries – battery performance parameters – charging and discharging characteristics – power density, energy density and safety issues – lead acid, nickel–cadmium, zinc–manganese dioxide and lithium-ion batteries – mathematical modeling of lead acid batteries – flow batteries.

MODULE - II ALTERNATE AND HYBRID ENERGY STORAGE TECHNOLOGIES 7

Flywheel energy storage – supercapacitors – principles and applications – compressed air energy storage – hybrid energy storage concepts – pumped hydro storage systems and applications.

MODULE - III HISTORY AND EVOLUTION OF ELECTRIC VEHICLES 8

History of electric vehicles – IC engines overview – BMEP and BSFC – vehicle fuel economy – emission control systems – diesel exhaust emission treatment – evolution of EVs and HEVs.

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MODULE - IV ENERGY STORAGE INTEGRATION AND VEHICLE PERFORMANCE **7**

Energy storage integration in electric vehicles – role of batteries, super capacitors, and hybrid energy storage systems – energy flow in EVs – integration of energy storage with electric drive train – performance analysis of EVs using drive cycles – vehicle dynamics fundamentals – tire-road interaction – tractive effort, power and energy requirements – energy consumption analysis for electric vehicles – performance considerations for electric vehicles in hilly terrains and heavy-duty applications.

MODULE - V ELECTRIC VEHICLE POWERTRAIN AND ENERGY RECOVERY SYSTEMS **7**

EV powertrain architecture – key components: electric motor, inverter, transmission, differential and control unit – sizing of EV powertrain components based on vehicle requirements – energy storage system sizing for EV applications – power flow between battery and propulsion system – regenerative braking systems – comparison of regenerative and conventional braking – energy recovery techniques in EVs – numerical examples related to powertrain and energy recovery.

MODULE - VI ADVANCED ENERGY STORAGE SYSTEMS AND PLUG-IN ELECTRIC VEHICLES **8**

Advanced energy storage technologies for EVs – lithium-ion battery developments, solid-state batteries, supercapacitors and fuel cells – hybrid energy storage systems – battery management systems (BMS) – thermal management of batteries – charging methods and charging infrastructure – plug-in electric vehicles and plug-in hybrid electric vehicles – construction, block diagram and operation – charging mechanisms and grid interaction – advantages, challenges and applications of plug-in electric vehicles.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Sandeep Dhameja, Fundamentals of Electric Vehicles, 2nd Edition, Pearson Education, 2019.
2. Davide Andrea, Battery Management Systems for Large Lithium Ion Battery Packs, 1st Edition, Artech House, 2010.

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REFERENCE BOOKS

1. Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles, 3rd Revised Edition, CRC Press, 2018.
2. K.T. Chau, Energy Storage Systems in Electric Vehicles, 1st Edition, Wiley, 2015.
3. John G. Hayes and G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, 1st Edition, Wiley, 2018.
4. James Larminie and John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley, 2012.
5. Chris Mi, M. Abul Masrur and David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, 2nd Edition, Wiley, 2011.

WEB RESOURCES:

1. https://afdc.energy.gov/
2. https://www.iea.org/reports/global-ev-outlook
3. https://www.nrel.gov/
4. https://ocw.mit.edu
5. https://www.sae.org

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_ee18/preview
2. https://archive.nptel.ac.in/courses/108/106/108106182/
3. https://www.classcentral.com/course/swayam-charging-infrastructure-452073
4. https://archive.nptel.ac.in/courses/108/106/108106170/
5. https://archive.nptel.ac.in/courses/108/103/108103009/

OUTCOMES:

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

1. Build the battery technologies, performance parameters and basic modeling concepts used in electric vehicles. (K3)
2. Identify the different alternate energy storage systems and explain their applications in electric and hybrid electric vehicles. (K3)

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3. Develop performance characteristics of Electric Vehicles and Hybrid Electric Vehicles. (K3)
4. Apply EV performance based on vehicle dynamics, traction requirements, and energy consumption under different operating conditions. (K3)
5. Select the operation of EV powertrain systems and the effectiveness of regenerative braking in improving vehicle efficiency. (K3)
6. Develop the operating principles and charging mechanisms of plug-in electric vehicles and their charging infrastructure. (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	2	1	-	-	-	-	-	-	-	2	1
CO3	3	3	2	1	-	-	-	-	-	-	-	2	1
CO4	3	3	2	1	-	-	-	-	-	-	-	2	2
CO5	3	2	2	1	-	-	-	-	-	-	-	2	2
CO6	2	2	3	1	-	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MUEL512	ELECTRIC VEHICLE ECOSYSTEM	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108107002	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 12, 15				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To Understand the fundamentals and evolution of electric vehicles.
- To Study the components and architecture of EVs.
- To Analyze energy storage technologies and battery management systems.

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- To Examine electric propulsion systems and power electronics.
- To Understand charging infrastructure and smart grid integration.
- To Explore EV ecosystem aspects including policies, sustainability, and business models.

MODULE - I INTRODUCTION TO ELECTRIC VEHICLES AND EV ECOSYSTEM **8**

Evolution of electric mobility - Global and Indian EV market trends - Types of electric vehicles: Battery Electric Vehicles (BEV), Hybrid Electric Vehicles (HEV), Plug-in Hybrid Electric Vehicles (PHEV), Fuel Cell Electric Vehicles (FCEV). Overview of EV ecosystem: Manufacturing, Charging infrastructure, Power grid, Policies and regulations - Environmental benefits and challenges.

MODULE - II ELECTRIC VEHICLE ARCHITECTURE AND COMPONENTS **8**

EV architecture and block diagram - Key components: Electric motor, Battery pack, Power electronics converter, Transmission system, Control unit. - Vehicle dynamics and performance parameters - Traction system requirements - Regenerative braking system.

MODULE - III ENERGY STORAGE SYSTEMS **7**

Battery technologies: Lead-acid, Nickel-Metal Hydride, Lithium-ion, Solid-state batteries. Battery characteristics: Energy density, Power density, Charging cycles. Battery modelling and thermal management - Battery Management System (BMS) - Supercapacitors and fuel cells.

MODULE - IV ELECTRIC PROPULSION SYSTEMS **7**

Electric traction motors: DC motors, Induction motors, Permanent Magnet Synchronous Motor (PMSM), Brushless DC motor (BLDC), Switched Reluctance Motor (SRM). Motor characteristics and selection - Power electronics converters: DC-DC converters, Inverters. Motor drive control strategies.

MODULE - V CHARGING INFRASTRUCTURE AND GRID INTEGRATION **7**

Charging methods: Level 1 charging, Level 2 charging, DC fast charging. Charging standards and connectors - Wireless charging technology - Smart charging systems - Vehicle-to-Grid (V2G) technology - Integration with renewable energy.

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MODULE - VI EV ECOSYSTEM, POLICIES, AND SUSTAINABILITY 8

EV supply chain and manufacturing ecosystem - Government policies and incentives - EV business models - Battery recycling and second-life applications - Environmental impact assessment - Future trends: Autonomous EVs, Smart mobility, Energy transition.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Robert Bosch GmbH, Driving Electric Vehicles, 1st Edition, Springer Vieweg, 2018.
2. Chris Mi, M. Abul Masrur and David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, 2nd Edition, Wiley, 2017.

REFERENCE BOOKS

1. Mehrdad Ehsani – Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, 3rd Edition, CRC Press, 2018.
2. Iqbal Husain – Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021.
3. Davide Andrea, Battery Management Systems for Large Lithium Ion Battery Packs, 1st Edition, Artech House, 2010.
4. James Larminie and John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley, 2012.
5. Lino Guzzella – Vehicle Propulsion Systems, Springer, 2013.

WEB RESOURCES:

1. https://theicct.org/
2. https://www.iea.org/reports/global-ev-outlook
3. https://elearn.nptel.ac.in/shop/executive-workshops/execedu-ongoing/certificate-programme-on-emobility-cpoem-cohort-7/
4. https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/emobility-and-electric-vehicle-engineering-cohort-3/
5. https://elearn.nptel.ac.in/shop/executive-workshops/execedu-ongoing/certificate-program-on-electric-vehicles-cpev/

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ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc25_ee134/preview
2. https://onlinecourses.nptel.ac.in/noc24_ee148/preview
3. https://nptel.ac.in/courses/108105159
4. https://nptel.ac.in/courses/108106170
5. https://nptel.ac.in/courses/108105058

OUTCOMES:

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

1. Choose the concept, structure, and major elements of the electric vehicle (EV) ecosystem, and energy management systems. (K3)
2. Identify the key components and architecture of electric vehicles. (K3)
3. Develop the working principles and characteristics of various energy storage technologies used in EVs. (K3)
4. Construct the operation of electric propulsion systems and motor drives used in electric vehicles. (K3)
5. Select the types of EV charging infrastructure and the basic concepts of grid integration for electric vehicles. (K3)
6. Choose the policy, environmental, and business aspects related to the development and adoption of electric vehicles. (K3)

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL516	RAPID MANUFACTURING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112104265	SYLLABUS VERSION 1.0	SDG NO. 4, 7, 9, 11, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To introduce the concepts, technologies, and applications of Rapid Manufacturing.
- To develop competency in product design and Design for Rapid Manufacturing principles.
- To understand reverse engineering, 3D scanning, and digital product development techniques.
- To study polymerization, powder-bed, liquid-based, sheet-stacking, and beam-deposition manufacturing processes.
- To understand with additive manufacturing materials, post-processing operations.
- To enable integration of CAD/CAE/CIM tools for rapid product development and industrial implementation of RM technologies.

MODULE - I INTRODUCTION TO RAPID MANUFACTURING AND PRODUCT DESIGN 7

Introduction to Rapid Manufacturing (RM): Evolution of RM, Additive Manufacturing versus Conventional Manufacturing, Classification of RM Technologies, Advantages, Limitations and Applications of RM - Product Design Process- Product Development Cycle, Design Methodologies, Concept Generation, Product Realization Process, Design Evaluation and Optimization, Role of RM in Product Development.

MODULE - II DESIGN FOR RAPID MANUFACTURING 8

Design for Modularity: Fundamentals of Modular Design, Design for Assembly (DFA), Design for Customization, Product Architecture and Modular Product Development. Reverse Engineering and 3D Measurement- Principles of Reverse Engineering, Reverse Engineering Process, Data Acquisition

Recommended in Board of Studies (BoS) Meeting No. 11 held on

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Techniques, 3D Scanning Technologies, Geometric Data Processing, Coordinate Measuring Systems, Laboratory Demonstration of 3D Measurement.

MODULE - III POLYMERIZATION AND POWDER-BASED RAPID MANUFACTURING PROCESSES **7**

Polymerization-Based Processes: Principles, Process Parameters and Applications of Stereolithography (SLA) and Related Photopolymerization Techniques. Powder-Based Processes: Powder Bed Fusion Technologies, Selective Laser Sintering (SLS), Selective Laser Melting (SLM), Process Characteristics, Advantages, Limitations and Industrial Applications.

MODULE - IV LIQUID-BASED, SHEET STACKING AND 3D PRINTING PROCESSES **8**

Liquid-Based Processes: Material Jetting Technologies, Inkjet-Based Manufacturing Systems, Process Parameters and Applications. Sheet Stacking Processes: Laminated Object Manufacturing (LOM), Sheet Lamination Techniques, Process Characteristics and Applications.3D Printing Processes: Binder Jetting, Material Extrusion, Fused Deposition Modeling (FDM), Process Planning, Laboratory Demonstration of 3D Printing Systems.

MODULE - V BEAM DEPOSITION PROCESSES, MATERIALS AND POST-PROCESSING **7**

Beam Deposition Processes: Directed Energy Deposition (DED), Laser-Based and Electron Beam-Based Manufacturing Processes, Process Characteristics and Applications. Materials in RM: Polymers, Metals, Ceramics and Composite Materials for Additive Manufacturing. Post-Processing and Costing: Surface Finishing, Heat Treatment, Support Removal, Inspection and Quality Assessment, Cost Estimation and Economic Analysis of RM Processes.

MODULE - VI RAPID PRODUCT DEVELOPMENT AND INDUSTRIAL APPLICATIONS **8**

Rapid Product Development (RPD): Integration of CAD, CAE and CIM in Product Development, Digital Manufacturing Workflow, Design Validation and Optimization.Software Demonstration and Case Studies: RM Software Tools, Data Preparation and Process Simulation, Industrial Case Studies, Emerging Trends and Future Scope of Rapid Manufacturing.

TOTAL : 45 PERIODS

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Recommended in Board of Studies (BoS) Meeting No. 11 **held** Mechanical Engineering

TEXT BOOK:

1. Chua, C.K., Leong, K.F. and Lim, C.S.Rapid Prototyping: Principles and Applications, 3rd Edition, World Scientific Publishing, 2010.
2. Gibson, I., Rosen, D.W. and Stucker, B. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2021.
3. Groover, M.P.Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 7th Edition, Wiley, 2023.
4. Hopkinson, N., Hague, R.J.M. and Dickens, P.M. Rapid Manufacturing: An Industrial Revolution for the Digital Age, John Wiley & Sons, 2006.

REFERENCES:

1. Ashby, M.F. and Johnson, K.Materials and Design: The Art and Science of Material Selection in Product Design, Butterworth-Heinemann, 2014.
2. Ulrich, K.T. and Eppinger, S.D. Product Design and Development, 7th Edition, McGraw-Hill Education, 2020.
3. Kai V. Wong and Aldo Hernandez A Review of Additive Manufacturing, ISRN Mechanical Engineering Publications.
4. Dimitrov, D., Schreve, K. and de Beer, N.Advances in Three-Dimensional Printing – State of the Art and Future Perspectives, RapidTech Publications.

WEB REFERENCES:

1. http://www.digimat.in/nptel/courses/video/112104265/L11.html
2. http://digimat.in/nptel/courses/video/112104265/L25.html
3. https://nptel.ac.in/courses/112103306

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg70
2. https://nptel.ac.in/courses/113108632

OUTCOMES:

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

1. Illustrate the concepts, technologies, advantages, limitations, and applications of Rapid Manufacturing and Product Design. (K3)
2. Apply design methodologies, reverse engineering, and 3D measurement techniques for rapid product development. (K3)
3. Analyze polymerization-based and powder-bed additive manufacturing processes for engineering applications. (K4)

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4. Apply liquid-based, sheet stacking, and extrusion-based manufacturing processes for product realization.(K4)
5. Identify suitable materials, post-processing methods, and costing approaches for additive manufacturing systems. (K4)
6. Evaluate digital manufacturing solutions by integrating CAD/CAE/CIM tools and assess industrial applications of Rapid Manufacturing. (K3)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL517	CASTING AND WELDING PROCESSES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 1031077125	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To apply fundamental concepts of casting and welding in manufacturing
- To analyze process parameters and defects in casting and welding
- To evaluate suitable manufacturing processes for engineering applications

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MODULE - I FUNDAMENTALS OF CASTING 7

Introduction to manufacturing and casting, Solidification process and structure formation Patterns: types, materials, allowances, Moulding materials and properties, Moulding methods and equipment.

MODULE - II CASTING PROCESSES 8

Sand casting and core making, Special casting processes: Die casting, Investment casting, Centrifugal casting Furnaces for melting metals, Gating and risering design, Selection of casting process for applications.

MODULE - III CASTING DEFECTS & INSPECTION 7

Types of casting defects and causes, Solidification defects and remedies, Non-destructive testing (NDT) methods, Quality control in casting, Case studies and defect analysis.

MODULE - IV FUNDAMENTALS OF WELDING 8

Principles of welding and heat sources, Welding metallurgy basics, Types of welding joints and positions, Weldability of materials, Safety in welding.

MODULE - V WELDING PROCESSES 7

Arc welding, Gas welding, Resistance welding, Solid-state welding (friction, diffusion), Advanced welding: Laser, Electron beam, Selection of welding processes

MODULE - VI WELDING DEFECTS, INSPECTION & APPLICATIONS 8

Welding defects and causes, Residual stresses and distortion, Testing of weld joints (Destructive & NDT), Automation and robotics in welding, Industrial applications and case studies.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Welding Engineering & Technology R.S.Parmer – Khanna Publishers – 2002.
2. Principle of metal casting – Heime, Looper and Rosenthal – Tata McGraw Hill – 2001

REFERENCES

1. Principle of Foundry Technology – P.L.John Tata McGraw Hill – 2003
2. Modern Welding Technology – B.Curry – Prentice Hall – 2002

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3. Welding Principle & applications – Larry Jeffin Delmar – 1997
4. Foundry Engineering – Taylor HF Fleming, M.C. & Wiley Eastern Ltd., 93

WEB REFERENCES:

1. https://www.efoundry.iitb.ac.in
2. https://www.afsinc.org
3. https://www.afscads.com
4. https://www.foundrygate.com
5. https://www.aws.org
6. https://www.aws.org/standards-and-publications
7. https://materialwelding.com
8. https://www.twi-global.com
9. https://www.lincolnelectric.com
10. https://www.esab.com

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me107
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me118
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg123
4. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me191

OUTCOMES:

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

1. Demonstrate fundamental concepts of casting processes and moulding techniques in manufacturing practice. (K3)
2. Differentiate various casting methods and select appropriate processes based on material and design requirements. (K4)
3. Examine casting defects and determine suitable inspection techniques for quality improvement. (K4)
4. Illustrate welding principles and joint configurations for engineering applications. (K3)
5. Assess welding processes and process parameters for different materials and operating conditions. (K4)
6. Investigate welding defects and evaluate appropriate quality control and testing methods. (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	-	2	-	-	-	-	-	-	3	2
CO2	3	2	2	2	2	-	-	-	-	-	-	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	3	2
CO4	3	3	2	2	2	-	2	-	-	-	-	3	2
CO5	3	3	3	2	3	-	2	-	-	-	-	3	3
CO6	2	2	3	2	3	2	3	-	-	2	-	2	3

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL518	TESTING OF MATERIALS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112107259	SYLLABUS VERSION 1.0	SDG NO. 3, 4, 8, 9, 12				
PRE-REQUISITE COURSES	24MUPL401					

OBJECTIVES:

- To examine advanced destructive and non-destructive material testing methodologies used in modern industries.
- To investigate material characterization and failure assessment techniques for engineering applications.
- To evaluate digital and intelligent testing approaches for reliability and quality enhancement in mechanical systems.

MODULE - I INTRODUCTION TO MATERIAL TESTING **5**

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

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MODULE - II MECHANICAL TESTING **8**

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) – Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test – Principles, Techniques, Methods, Advantages and Limitations, Applications.

MODULE - III NON-DESTRUCTIVE TESTING **8**

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission – Principles, Techniques, Methods, Advantages and Limitations, Applications.

MODULE - IV MATERIAL CHARACTERIZATION TESTING **8**

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) – Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques – Principles, Types, Advantages and Limitations, Applications.

MODULE - V THERMAL AND CHEMICAL CHARACTERIZATION TECHNIQUES **8**

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis, Thermomechanical and Dynamic mechanical analysis: Principles, Advantages, Applications.

Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

MODULE - VI ADVANCED MATERIAL TESTING AND DIGITAL EVALUATION **8**

Smart material testing methodologies, AI-assisted defect prediction, Digital Image Correlation (DIC), Infrared thermographic evaluation, Residual stress measurement techniques, Nano-indentation testing, Fracture surface analysis using advanced microscopy, Additive manufacturing material testing standards, Structural health monitoring (SHM), Real-time sensor-based testing systems, Machine learning applications in failure prediction, Data acquisition and automated test interpretation, Industry 4.0 approaches in material inspection and reliability engineering.

TOTAL : 45 PERIODS

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TEXT BOOK:

1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non-Destructive Testing, Narosa Publishing House, 3rd Edition, 2018.
2. ASM International, ASM Handbook Volume 17: Nondestructive Evaluation and Quality Control, ASM International, 2018.
3. R. K. Rajput, Material Science and Engineering Testing Methods, S. Chand Publications, 2021.

REFERENCES:

1. George E. Dieter and David Bacon, Mechanical Metallurgy, McGraw Hill Education, 3rd Edition, 2017.
2. Davis J.R., Tensile Testing, ASM International, 2nd Edition, 2019.
3. Hellier Charles, Handbook of Non-Destructive Evaluation, McGraw Hill, 3rd Edition, 2020.
4. Cullity B.D. and Stock S.R., Elements of X-Ray Diffraction, Pearson Education, 3rd Edition, 2019.
5. Richard C. Hibbeler, Mechanics of Materials, Pearson, 11th Edition, 2022.

WEB REFERENCES:

1. https://onlinecourses-archive.nptel.ac.in/noc17_mm08/preview
2. https://onlinecourses.nptel.ac.in/noc25_mm61/preview
3. https://onlinecourses.nptel.ac.in/noc24_mm18/preview

ONLINE RESOURCES:

1. https://www.asminternational.org
2. https://www.astm.org
3. https://www.azom.com
4. https://www.olympus-ims.com/en/ndt-tutorials

OUTCOMES:

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

1. Differentiate destructive and non-destructive testing techniques for industrial material evaluation. (K4)
2. Examine mechanical testing data to determine material behaviour under varying loading conditions. (K4)
3. Evaluate suitable non-destructive inspection techniques for defect identification in engineering components. (K5)

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4. Critique material characterization techniques for microstructural and compositional analysis. (K5)
5. Assess thermal and chemical testing methods for advanced engineering material applications. (K5)
6. Formulate intelligent testing and digital evaluation strategies for modern manufacturing environments. (K5)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24EEEL525	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	-					

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

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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.

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

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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.

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

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24EEEL526	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					

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

PROFESSIONAL ELECTIVE - II

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	-					

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:

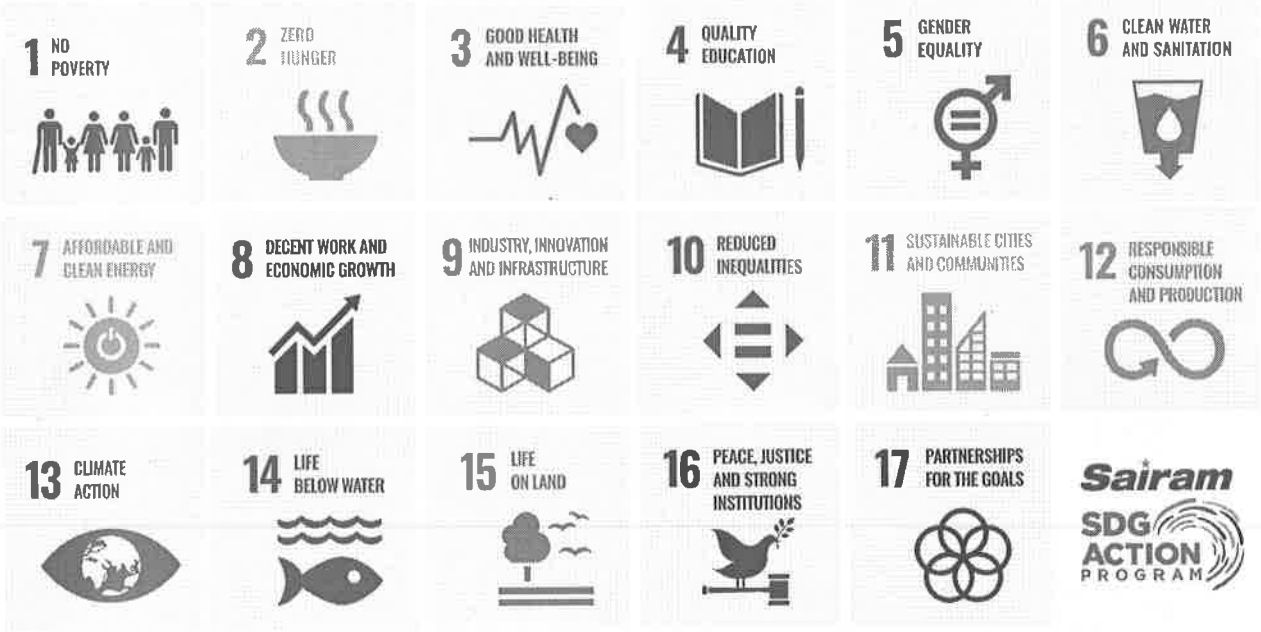
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	-	-	-	2	1
CO2	3	2	2	-	-	-	-	-	-	-	-	2	2
CO3	3	2	3	-	2	1	-	-	-	-	-	3	2
CO4	3	2	3	-	2	1	1	-	-	-	-	3	2
CO5	2	2	-	3	3	2	1	-	1	-	-	2	1
CO6	3	2	2	1	2	2	-	-	1	-	2	2	1

Recommended in Board of Studies (BoS) Meeting No. 8 held on 6/1/26

CHAIRMAN
Board of Studies
Electrical and Electronics Engineering

Imagine the Future and

Make it happen!



Together let's build a better world where there is NO POVERTY and ZERO HUNGER. We have GOOD HEALTH AND WELL BEING QUALITY EDUCATION and full GENDER EQUALITY everywhere. There is CLEAN WATER AND SANITATION for everyone. AFFORDABLE AND CLEAN ENERGY which will help to create DECENT WORK AND ECONOMIC GROWTH. Our prosperity shall be fuelled by investments in INDUSTRY, INNOVATION AND INFRASTRUCTURE that will help us to REDUCE INEQUALITIES by all means. We will live in SUSTAINABLE CITIES AND COMMUNITIES. RESPONSIBLE CONSUMPTION AND PRODUCTION will help in healing our planet. CLIMATE ACTION will reduce global warming and we will have abundant, flourishing LIFE BELOW WATER, rich and diverse LIFE ON LAND. We will enjoy PEACE AND JUSTICE through STRONG INSTITUTIONS and will build long term PARTNERSHIPS FOR THE GOALS.

For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and **People like you.**

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*and **NIRF** ranked institution*

College Campus
Sai Leo Nagar, West Tambaram,
Chennai - 600 044. Ph : 044-2251 2222

Administrative Office
"Sai Bhavan", 31B, Madley Road, T.Nagar,
Chennai - 600 017. Ph : 044-4226 7777

e-mail : sairam@sairamgroup.in

www.sairamgroup.in

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MJF. LN. LEO MUTHU
Founder Chairman - Sairam Institutions