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 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 ENGINEERING

VISION

To establish a renowned department for its technological and engineering expertise by delivering quality education and addressing industry needs to tackle societal challenges.

MISSION

Department of Mechanical Engineering, SRI SAIRAM ENGINEERING COLLEGE is committed to

M1 Equip Students with exceptional knowledge and skills for a successful career in Engineering and Technology.

M2 Inspire students to pursue higher studies by achieving excellence in engineering and technology.

M3 Encourage students to understand industry needs and develop entrepreneurial skills.

M4 Instill in students an understanding of the significance of ethical values in society.

M5 Build students to embrace lifelong learning.

AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2024

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 Lab	0	0	4	4	2
VALUE ADDITIONS - II							
1	24ENTP201	Digital Dynamics	0	0	2	2	0
2	24ESID201	Idea Engineering Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24ESMC201	MS Office (Mandatory - NC)	0	0	0	0	0
				Total		24	19

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

Approved by
Academic Council Meeting
No. 8 Dated: 03/9/2024

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Board of Studies
Mechanical Engineering

AUTONOMOUS CURRICULA AND SYLLABI
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SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24BSMA304	Transforms and Numerical Methods	3	1	0	4	4
2	24MEPC301	Engineering Thermodynamics	3	0	0	3	3
3	24CEPC305	Fluid Mechanics and Machinery	3	0	0	3	3
4	24MEPC302	Engineering Metallurgy	3	0	0	3	3
5	24MEPW301	Manufacturing Process with Laboratory	3	0	2	5	4
6	24HSMC301	Universal Human Values - II	2	1	0	3	3
7	24HSNC301	NCC course Level 2*	3*	0	0	3*	0
PRACTICALS							
1	24MEPL301	Computer Aided Machine Drawing Laboratory	0	0	4	4	2
VALUE ADDITIONS - III							
1	24METP301	Aptitude skills	0	0	2	2	1
2	24MEID301	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		31	24

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24MEPC401	Thermal Engineering	3	0	0	3	3
2	24MEPC402	Metrology and Measurements	3	0	0	3	3
3	24MEPC403	Theory of Machines	3	0	0	3	3
4	24CEPC405	Strength of Materials	3	0	0	3	3
5	24MEPW401	Machine Tool Technology with Laboratory	3	0	2	5	4
6	24xxOE9xx	Open Elective - I#	3	0	0	3	3
7	24HSNC401	NCC course Level 3*	3	0	0	3*	0
PRACTICALS							
1	24CEPL403	Strength of Materials and Fluid Mechanics & Machinery Laboratory	0	0	4	4	2
2	24MEPT401	Dynamics & Metrology Laboratory with Theory	1	0	4	5	3
VALUE ADDITIONS - IV							
1	24METP401	Aptitude skills	0	0	2	2	0
2	24MEID401	Innovative Design Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BoS		Total		33	25

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

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SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24MEPC501	Heat Transfer	3	0	0	3	3
2	24MEPC502	Design of Machine Elements	3	0	0	3	3
3	24MEEL5xx	Professional Elective – I	3	0	0	3	3
4	24MEEL5yy	Professional Elective – II	3	0	0	3	3
5	24SCOE901	Open Elective - II#	3	0	0	3	3
6	24MGMC501	Constitution of India	2	0	0	2	0
		PRACTICALS					
1	24MEPL501	Heat Transfer and IC Engines Laboratory	0	0	4	4	2
2	24MEPL502	CAD/ CAM Laboratory	0	0	4	4	2
		VALUE ADDITIONS - V					
1	24METP501	Skill Enhancement	0	0	2	2	1
2	24MEID501	Prototype Development Lab - I	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
		As recommended by BoS		**Total**		**29**	**21**

Department Specific Cyber Security Course

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24MEPC601	Design of Transmission Systems	3	0	0	3	3
2	24MEPC602	Finite Element Analysis	3	0	0	3	3
3	24MEEL6xx	Professional Elective - III	3	0	0	3	3
4	24MEEL6yy	Professional Elective - IV	3	0	0	3	3
5	24HSMG501	Principles of Engineering Management	3	0	0	3	3
6	24xxOE9xx	Open Elective - III	3	0	0	3	3
		PRACTICALS					
1	24MEPL601	Simulation and Analysis Laboratory	0	0	4	4	2
		VALUE ADDITIONS - II					
1	24METP601	Technical Skill	0	0	2	2	0
2	24MEID601	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	24MEPC701	Mechatronics and IoT	3	0	0	3	3
2	24MEEL7xx	Professional Elective - V	3	0	0	3	3
3	24MEEL7yy	Professional Elective - VI	3	0	0	3	3
5	24XXOE9xx	Open Elective - IV	3	0	0	3	3
6	24MGEL703	Creative Innovation and Entrepreneurship	2	0	0	2	2
PRACTICALS							
1	24MEPL701	Mechatronics & Robotics Lab	0	0	4	4	2
2	24MEPJ701	Project work - Phase I	0	0	8	8	4
VALUE ADDITIONS - VII							
1	24METP701	Company Specific Skills	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BoS					
				Total		31	24

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24MEEL7zz	Professional Elective – VII	3	0	0	3	3
PRACTICALS							
1	24MEPJ801	Project Work - Phase II	0	0	12	12	6
VALUE ADDITIONS - VIII							
1	24MEIN801	Internship	0	0	9	9	3
				Total		24	12

CREDIT DISTRIBUTION

Category	BS	ES	HS	EL	PC+PL	PW	PT	OE	TP	PJ+ID	IS	MC	TOTAL
Credit	26	15	13	23	45	8	3	12	4	16	3	Y	168
Percentage	15.48	8.93	7.74	13.69	26.79	4.76	1.79	7.14	2.38	9.52	1.79	-	

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No. 8 Dated: 03/9/2024

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PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24MEEL501	Alternative Fuels	3	Energy Engineering	-
2	24MEEL502	Measurements in Thermal Engineering	3	Energy Engineering	24MEPC402
3	24MEEL503	Renewable Energy Sources	3	Energy Engineering	24BSCY201
4	24MEEL504	Non-Destructive Testing and Evaluation	3	Materials & Manufacturing	
5	24MEEL505	Material Joining Techniques	3	Materials & Manufacturing	
6	24MEEL506	CNC Machine Tools and Programming	3	Materials & Manufacturing	
7	24MEEL507	Applied Hydraulics and Pneumatics	3	Engineering Design	24CEPC305, 24ESCE201
8	24MEEL508	Industrial Robotics and Material Handling Systems	3	Engineering Design	24MEPC403
9	24MEEL509	Reverse Engineering	3	Engineering Design	24MEPW301
10	24MEEL510	Automation in Production Systems and Management	3	Industrial Engineering	
11	24MEEL511	Lean and Agile Manufacturing	3	Industrial Engineering	
12	24MEEL512	Digital Manufacturing	3	Industrial Engineering	

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24MEEL513	Basic Environmental Engineering and Pollution Abatement	3	Energy Engineering	24MEPC401
2	24MEEL514	Internal Combustion Engines	3	Energy Engineering	
3	24MEEL515	Solar Energy Systems	3	Energy Engineering	
4	24MEEL516	Rapid Manufacturing	3	Materials & Manufacturing	
5	24MEEL517	Casting and Welding Processes	3	Materials & Manufacturing	
6	24MEEL518	Testing of Materials	3	Materials & Manufacturing	
7	24MEEL519	Ergonomics in Design	3	Engineering Design	24ESGE101
8	24MEEL520	Surface Engineering	3	Engineering Design	24MEPC302
9	24MEEL521	Composite Materials	3	Engineering Design	24BSPH202, 24MEPC302
10	24MEEL522	Safety Engineering and Management	3	Industrial Engineering	
11	24MEEL523	Six Sigma Quality	3	Industrial Engineering	
12	24MEEL524	Economics for Engineers	3	Industrial Engineering	

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No. 8 Dated: 03/9/2024

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Mechanical Engineering

INDUSTRY CONNECTED PROFESSIONAL ELECTIVES
Delphi TVS

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24MEIE501	Additive Manufacturing Processes	3	Materials and Manufacturing
2	24MEIE502	Advanced Fuel Injection System - I	3	Energy Engineering
3	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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Academic Council Meeting
No. 8 Dated: 25/1/2025

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Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Develop students to have a strong foundation in mechanical engineering principles, enabling them to become a successful Mechanical Engineer.

PEO2 Equip students with expertise in core domains such as Manufacturing, Design, and Thermal Sciences, aligning with industry requirements.

PEO3 Build students for professional careers in core and other industries through placement or entrepreneurship by upholding ethical values.

PEO4 Prepare students for higher studies by building a in depth knowledge in mechanical engineering.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon completion of program, the student will be able:

PSO 1 To stay updated in the field of mechanical engineering through subjective learning, industrial training and MOOC.

PSO 2 To design, engineer, and manufacture vehicles capable of performing optimally across all conditions while maintaining the engineering standards and ensuring durability, safety, and efficiency.

COMPONENTS OF THE CURRICULUM (COC)

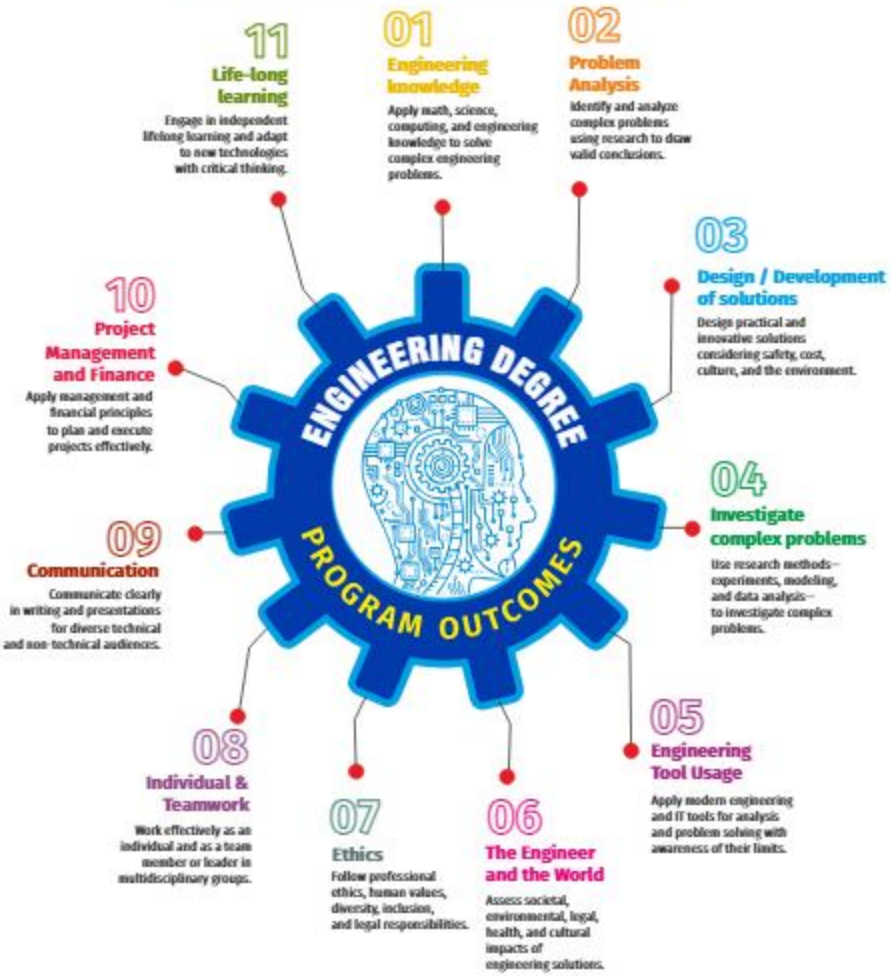
Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total Number of credits
Basic Sciences (BS)	15	28	26
Engineering Sciences (ES)	9	18	15
Humanities and Social Sciences (HS)	8	13	13
Professional Electives (EL)	14	23	23
Program Core + Program 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

Approved by
Academic Council Meeting
No. 8 Dated: 03/9/2024

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Mechanical Engineering

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



SEMESTER - I

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

OBJECTIVES:

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

MODULE I MATRICES 12

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

MODULE II FUNCTIONS OF SEVERAL VARIABLES 12

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

MODULE III VECTOR DIFFERENTIATION 4

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

MODULE IV VECTOR INTEGRATION 8

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

MODULE V MULTIPLE INTEGRALS 12

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

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

S. Ramachandran
CHAIRMAN
Board of Studies
Humanities & Science

MODULE VI FOURIER SERIES **12**

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

TOTAL: 60 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

WEB REFERENCES:

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

ONLINE RESOURCES:

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

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

S. Narasakrishnan
CHAIRMAN
Board of Studies
Humanities & Science

COURSE OUTCOMES:

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

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

CO-PO Mapping:

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

SEMESTER - I

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

OBJECTIVES:

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

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

S. Narasaka Srinivasa
CHAIRMAN
Board of Studies
Humanities & Science

MODULE - I COMMUNICATION PROCESS 8

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

MODULE - II LANGUAGE BARRIERS, LEVELS AND CHANNELS 8

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

MODULE - III NARRATION AND SUMMATION 8

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

MODULE - IV WRITING MECHANICS 7

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

MODULE - V INTERPRETATION SKILLS 7

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

MODULE - VI COGENT EXPOSITIONS 7

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

TOTAL: 45 PERIODS

Recommended by
Board of Studies of S&H dept.
Meeting No. 6 Dated: 31/05/2019

S. Namakrishnan
CHAIRMAN
Board of Studies
Humanities & Science

TEXT BOOKS:

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

REFERENCES:

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

WEB REFERENCES:

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

Recommended by
Board of Studies of S&H dept.
Meeting No. 6 Dated: 31/05/2023

S. Narasakrishnan
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Humanities & Science

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.

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

S. Nagakrishnan
CHAIRMAN
Board of Studies
Humanities & Science

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.

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Meeting No. 6 Dated: 31/05/2024

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Humanities & Science

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).

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

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MODULE - VI NANOCHEMISTRY 7

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

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

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

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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.

Recommended by
Board of Studies of CSE dept.
Meeting No. 7 Dated: 30/05/2024

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

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

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

MODULE - II BASICS OF C PROGRAMMING 7

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

MODULE - III ARRAYS AND STRINGS 8

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

MODULE - IV FUNCTIONS AND POINTERS 9

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

MODULE - V STRUCTURES 7

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

MODULE - VI FILE PROCESSING 7

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

Recommended by
Board of Studies of CSE dept.
Meeting No. 7 Dated: 30/05/2019

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 Hed dept.
Meeting No. 8 Dated: 1.6.24

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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 Mech dept.
Meeting No. 8 Dated: 1.6.24

CHAIRMAN
Board of Studies
Mechanical Engineering

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

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

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

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

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

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

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

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

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

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

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

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

TOTAL: 60 PERIODS

TEXT BOOKS:

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

Recommended by
Board of Studies of Mech dept.
Meeting No. 8 Dated: 1.6.24

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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: 1.6.24

CHAIRMAN
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

அலகு ஐ மொழி மற்றும் இலக்கியம்

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

UNIT I LANGUAGE AND LITERATURE 5

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural

அலகு II இடைகால மற்றும் நவீன இலக்கியங்கள்

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

Unit II MEDIEVAL AND MODERN LITERATURE 5

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

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

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

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

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

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அலகு IV நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

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

UNIT IV FOLK AND MARTIAL ARTS 5

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

அலகு V தமிழர்களின் திணைக் கோட்பாடுகள்

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

UNIT V THINAI CONCEPT OF TAMILS 5

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

அலகு VI இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

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

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

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

TOTAL: 30 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

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6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian> Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - „Sangam City Civilization on the 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. மொழிக் குடும்பங்களின் வரலாறு மற்றும் தமிழ் இலக்கியங்களை மதிப்பிடுகிறார்கள் Students evaluate the history of language families and Tamil literatures (K3)
2. பக்தி மரபுகளின் தாக்கம் பெற்ற தமிழ் இலக்கியங்களைப் புரிந்துகொள்கிறார்கள் Students understand Tamil literatures influenced by Philosophical and religious traditions (K3)
3. தமிழகத்தின் பாறை, சிற்பம், ஓவியம்- கலை மரபுகளைப் பகுப்பாய்வு செய்கிறார்கள் Students analyze the artistic traditions of Tamil Nadu such as rock art, sculpture, and painting (K3)
4. தமிழக நாட்டுப்புறக் கலைகள் மற்றும் தற்காப்புக் கலைகளின் மாண்புகளை உணர்ந்து கொள்கிறார்கள் Students realize the significance of Tamil Nadu's folk arts and martial arts (K3)
5. பழந்தமிழரின் திணையியல் வாழ்வியலை மீளாய்வு செய்கிறார்கள் Students re-examine the ecological lifestyle (Thinai-based life) of the ancient Tamils (K3)
6. தேசிய இயக்கம் மற்றும் இந்தியப் பண்பாட்டில் தமிழர்களின் பங்களிப்பினை நினைவுகூர்கிறார்கள் Students recall the contribution of Tamils to the National Movement and Indian culture (K3)

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CO- PO, PSO MAPPING

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

SEMESTER - I

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

PHYSICS LABORATORY (Any Five Experiments to be conducted)

OBJECTIVES:

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

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

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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.

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

(a) Total marks obtained by each student.

(b) The highest marks in each subject and the marks of the student who secured it.

(c) The student who obtained the highest total marks.

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

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

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

OUTCOMES:

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

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

CO-PO, PSO MAPPING:

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

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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

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- Targets of the Goals
- Indicators of the Targets

MODULE-3 SDG and Indian Gram Panchayat 3

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

MODULE-4 Government Schemes 4

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

MODULE-5 Community Engagement 4

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

MODULE-6 Idea Generation 12

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

TOTAL: 30 PERIODS

REFERENCES:

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

WEB REFERENCES

1. UN Sustainable Development Goals
2. https://srmuniv.digimat.in/nptel/courses/video/109106200/L30.html
3. https://avcoe.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	5	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 methods for solving first order equations.

MODULE - III SOLUTIONS OF FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS 9

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

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

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4. https://ocw.mit.edu/courses/18-303-linear-partial-differential-equations-fall-2006/d11b374a85c3fde55ec971fe587f8a50_heateqni.pdf

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	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-
CO6	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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Board of Studies of SH dept.
Meeting No. 6 Dated: 31/05/2019

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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 application.

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. NSC

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. Analyze the various phases, invariant phase reactions of the Iron-Carbon phase diagram, different microstructures and the impact of alloying elements in ferrous alloys (K4)
3. Have an insight into the different types of magnetic materials and their practical applications (K3)
4. Examine polarization mechanisms of dielectric materials and properties of superconducting materials, and explore their applications (K4)
5. Have an insight on new engineering materials such as metallic glasses, shape memory alloys, ceramics, composites, biomaterials and their applications (K3)
6. Analyze the synthesis, properties, and applications of nanomaterials in electronics, photonics, and biomedical fields (K4)

CO-PO MAPPING:

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

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SEMESTER - II

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

OBJECTIVES:

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

MODULE - I INTRODUCTION TO ENVIRONMENTAL SCIENCE 8

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

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

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

MODULE - II ATMOSPHERIC CHEMISTRY 7

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

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MODULE - III WATER CHEMISTRY 8

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

MODULE - IV SOIL CHEMISTRY AND SOLID WASTE MANAGEMENT 7

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

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

MODULE - V ENERGY AND ENVIRONMENT 8

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

MODULE - VI GREEN CHEMISTRY AND SUSTAINABILITY 7

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

Sustainable Development: Definition and concepts of sustainable

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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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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.

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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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Meeting No. 8 Dated: 06/06/2019

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Civil Engineering

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

அலகு-I நெசவு மற்றும் பானைத் தொழில்நுட்பம்

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

UNIT-I WEAVING AND POTTERY (CERAMIC) TECHNOLOGY 5

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

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

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Humanities & Science

அலகு -II சங்ககாலவடிவமைப்புகள்

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

UNIT-II SANGAM AGE DESIGNS 5

Designing and Structural construction - House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age- Details of Stage Constructions in Silappathikaram

அலகு -III பழங்காலகட்டிடத் தொழில்நுட்பம்

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

UNIT-III ANCIENT CONSTRUCTION TECHNOLOGY 5

Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses> Indo - Saracenic architecture at Madras during British Period.

அலகு- IV உற்பத்தித் தொழில்நுட்பம்

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

UNIT-IV MANUFACTURING TECHNOLOGY 5

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

அலகு - V வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்

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

UNIT-V AGRICULTURE AND IRRIGATION TECHNOLOGY 5

Dam, Tank, Ponds, Sluice, Significance of KumizhiThoompu of Chola Period> Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of

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Meeting No. 6 Dated: 31/05/2019

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Sea - Fisheries - Pearl - Conch diving -Ancient Knowledge of Ocean - Knowledge Specific Society.

அலகு-VI அறிவியல்தமிழ்மற்றும்கணித்தமிழ்

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய்தல் - தமிழ் மென் பொருட்கள் உருவாக்கம் - தமிழ் இணையக்கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

UNIT-VI SCIENTIFIC TAMIL & TAMIL COMPUTING 5

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

TOTAL: 30 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

OUTCOMES:

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

1. சங்ககால நெசவு மற்றும் பானைத்தொழில்நுட்பங்களைப் பற்றி அறிந்து கொள்ளுதல்

   To learn about the weaving and pottery (ceramic) technologies during the Sangam Age.(K2)

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2. சங்ககாலவடிவமைப்புகள் மற்றும் கட்டுமானக்கலையைப் புரிந்து கொள்ளுதல்
   To understand the designs and structural constructions during the Sangam period.(K2)
3. பண்டைய கால கட்டிடக்கலையின்நுட்பங்கள் மற்றும் கட்டிடவடி வமைப்புகளை ஆராய்தல்.
   To explore the techniques and architectural patterns of ancient Tamil structures.(K2)
4. உற்பத்தி மற்றும் உலோகவியல்தொழில்நுட்பங்களைப் பற்றி அறிதல்.
   To gain knowledge on manufacturing and metallurgical technologies of ancient Tamils.(K3)
5. வேளாண்மை, நீர்ப்பாசனம் மற்றும் கடல்சார்தொழில்நுட்பங்களைப் பற்றி அறிந்து கொள்ளுதல்.
   To understand agricultural> irrigation> and marine technologies of ancient Tamil society.(K3)
6. அறிவியல்தமிழ் மற்றும் கணித்தமிழின்வளர்ச்சியையும் அதன் கணினி பயன்பாடுகளையும் புரிந்து கொள்ளுதல்.
   To understand the development of Scientific Tamil and its applications in Tamil computing.(K3)

CO- PO, PSO MAPPING

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

SEMESTER - II

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

ARMY WING

NCC GENERAL 6

NCC 1 Aims, Objectives & Organization of NCC 1

NCC 2 Incentives 2

NCC 3 Duties of NCC Cadet 1

NCC 4 NCC Camps: Types & Conduct 2

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

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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	

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

Recommended by
Board of Studies of S&H dept.
Meeting No. 6 Dated: 21/05/2019

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

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

Recommended by
Board of Studies of S&H dept.
Meeting No. 6 Dated: 21/oct/19

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Humanities & Science

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

Reviewed by
Board of Studies of Mech dept.
Meeting No. 8 Dated: 1.6.24

CHAIRMAN
Board of Studies
Mechanical Engineering

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.

Recommended by
Board of Studies of Mech dept.
Meeting No. 8 Dated: 1.6.24

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Mechanical Engineering

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

Recommended by
Board of Studies of Mech dept.
Meeting No. 8 Dated: 1.6.24

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Mechanical Engineering

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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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

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

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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

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WTO Good Practices for Standardization

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	-	-

SEMESTER - II

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

OBJECTIVES:

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

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

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

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

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

MODULE-2 EMBEDDED SYSTEMS, IOT AND ROBOTICS 4

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

MODULE-3 BASICS OF MECHANICAL ENGINEERING 4

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

MODULE 4 ALIGNMENT AND MAPPING OF IDEAS 4

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

MODULE-5 ENTREPRENEURSHIP SKILLS 4

- Startup Awareness
- Entrepreneurship Opportunities
- Mock Presentations
- Innovation
- Novelty

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- Feasibility
- Presentation Skills

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

Evaluation Stages:

- First Round
- Second Round
- Idea Pitching

TOTAL: 30 PERIODS

REFERENCES:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020
2. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
3. Elements of Mechanical Engineering by N M Bhatt and J R Mehta, Mahajan Publishing House
4. Basic Mechanical Engineering by Pravin Kumar, Pearson Education
5. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
6. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2017.
7. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.

WEB REFERENCES

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

OUTCOMES:

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

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

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CO-PO, PSO MAPPING:

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

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SEMESTER - III

24BSMA304 - SDG NO. 4	TRANSFORMS AND NUMERICAL METHODS	L	T	P	CP	C
		3	1	0	5	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.

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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.

WEB RESOURCES:

1. https://www.vyssotski.ch/BasicsOfInstrumentation/LaplaceTransform.pdf
2. https://www.sjsu.edu/me/docs/hsu-Chapter%206%20Laplace%20transform.pdf

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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=AlysepirN3w
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	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2	2
CO5	3	-	-	-	-	-	-	-	-	-	-	2	2
CO6	-	3	-	-	-	-	-	-	-	-	-	3	2

SEMESTER - III

24MEPC301 112106310 SDG NO. 4,7,12,15	ENGINEERING THERMODYNAMICS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the basics of classical thermodynamics containing zeroth, first and second laws, and their corollaries.
- To apply the basics of first and second law for the analysis and design of thermal systems.
- To develop interest in subject by migrating to higher level for pursuing higher studies in the field.

MODULE - I BASIC CONCEPTS 7

Thermodynamic systems and their types, Basic concepts of continuum, Microscopic and Macroscopic approach, Intensive and extensive properties, Path and point functions, Thermodynamic Equilibrium; state, path and process, quasi-static, State Postulate, Caloric theory, Heat and work transfer definition comparison & sign convention. Displacement work and other modes of work, p-V diagram. Zeroth law of thermodynamics, concept of temperature and thermal equilibrium.

MODULE - II FIRST LAW OF THERMODYNAMICS 7

First law of thermodynamics, and its application to closed system, open systems, steady and unsteady flow processes.

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MODULE - III SECOND LAW OF THERMODYNAMICS, CARNOT THEORY AND ENTROPY **8**

Second Law of Thermodynamics, Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. High and low grade energy, Concept of Reversibility, Corollaries of second law, Carnot cycle , Reversed Carnot cycle, Coefficient of Performance, Clausius inequality, Concept of entropy, T-s diagram, entropy change for pure substances, principle of increase in entropy.

MODULE - IV PROPERTIES OF PURE SUBSTANCE, STEAM PROPERTIES AND RANKINE CYCLE **8**

Study of thermodynamic properties on p-v-T surface. Study of Steam Table and Mollier Chart, dryness fraction. Ideal and actual Rankine cycles, Rankine Cycle Improvisation Methods, Reheat and Regenerative cycles.

MODULE - V IDEAL, REAL GASES AND THERMODYNAMIC RELATIONS 7

Properties of Ideal and real gas - Equations of state for ideal and real gases. Reduced properties - Principle of Corresponding states. Generalized Compressibility Chart and its use, Maxwell relations, T ds Equations, Difference and ratio of heat capacities, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes.

MODULE - VI PSYCHROMETRY **8**

Psychrometry, humidity, wet and dry bulb temperature, Psychrometric charts, Property calculations of air and vapour mixtures using chart and expressions. Psychrometric processes, adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing and their Applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics", Fifth Edition,2017, Lakshmi Publishers.
2. Nag.P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw-Hill, New Delhi, 2013.
3. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

REFERENCES:

1. Yunus A. Cengel& Michael A. Boles, "Thermodynamics", 8th edition 2015.
2. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.

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Meeting No. 9 Dated: 21.3.25

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3. Borgnakke & Sonnatag, "Fundamental of Thermodynamics", 8th Edition, 2016.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/104/112104113/
2. https://nptel.ac.in/courses/112/108/112108148/
3. https://ww.mcgoodwin.net/pages/thermodynamics.pdf

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/101/104/101104067/
5. https://nptel.ac.in/courses/112/105/112105220/
6. https://nptel.ac.in/courses/112/105/112105266/
7. https://nptel.ac.in/courses/112/103/112103275/

OUTCOMES

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

1. Apply basics of thermodynamics and its importance to universe and to different engineering systems. [K3]
2. Implement first law for open and closed systems and its application to thermal systems. [K3]
3. Illustrate second law of thermodynamics and its application to thermal devices, and understand concept of entropy. [K3]
4. Use properties model of steam and explain Rankine cycle and its application to steam power plant. [K3]
5. Examine ideal and real substance and derive various gas equations for real substance using Maxwell's theorem. [K4]
6. Predict the properties of gas mixtures, moisture and its application for various psychometric processes and basics of Refrigeration and Air-conditioning. [K3].

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CO – PO, PSO MAPPING:

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

SEMESTER - III

24CEPC305 112105206 SDG NO. 4,6,9,14	FLUID MECHANICS AND MACHINERY	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To Understand Fundamental Fluid Properties and Static Behavior.
- To Apply Fluid Kinematics and Dynamics in Engineering Applications.
- To Analyze Internal and External Fluid Flow Phenomena.
- To Utilize Dimensional and Model Analysis for Fluid Systems.
- To Examine Hydraulic Machines.
- To Examine Pumping Systems.

MODULE - I FUNDAMENTALS OF FLUID MECHANICS 8

PROPERTIES OF FLUID – Introduction – Properties of Fluids, Density, Specific Weight, Specific Volume and Specific Gravity – Viscosity – Compressibility and Bulk Modulus – Surface tension and Capillarity – Vapour pressure and Cavitation.

FLUID STATICS AND FLOATING BODIES - Pressure Measurement - Pressure at a point, Pascal's Law, Pressure variation in a fluid at rest. Buoyancy, Centre of Buoyancy, Types of Equilibrium of Floating Bodies.

MODULE - II FLOW CHARACTERISTICS: KINEMATICS AND DYNAMICS 8

FLUID KINEMATICS - Introduction - Description of Fluid Motion - Types of Fluid Flow - Rate of Flow - Continuity Equation - Continuity Equation in Cartesian Coordinates.

FLUID DYNAMICS - Introduction - Equations of motion - Euler's Equation for Motion - Bernoulli's Equation for Real Fluid - Practical Applications of

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Bernoulli's Equation Venturimeter, Orifice meter, Rotameter, Pitot Tube - Impulse-Momentum Equation - Moment of Momentum Equation.

MODULE - III LAMINAR FLOW AND BOUNDARY LAYER THEORY 8

LAMINAR FLOW - Introduction - Reynolds Experiment - Laminar Flow in Circular Pipes - Major losses - Darcy Weisbach equation - Friction Factor - Minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel.

BOUNDARY LAYER THEORY - Introduction - Boundary Layer Definitions and Characteristics - Boundary layer thickness - Displacement thickness - Momentum thickness - Energy thickness.

MODULE - IV DIMENSIONAL AND MODEL ANALYSIS 7

DIMENSIONAL ANALYSIS - Introduction - Fundamental dimensions - Dimensional homogeneity - Buckingham Pi theorem.

MODEL ANALYSIS - Introduction - Similitude - Types of Similarities- Dimensionless Number - Similitude and model studies - Distorted and undistorted models.

MODULE - V HYDRAULIC MACHINES – TURBINES 7

Introduction - Theory of rotodynamic machines - Classification of turbines - Working principles - Velocity Triangles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

MODULE - VI PUMPS 7

Introduction - Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Discharge, Work Done and Power Required to Drive Reciprocating Pump - Coefficient of Discharge and Slip of Reciprocating Pump.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Dr R K Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, 5th Edition, Laxmi Publication, 2012.
2. Cengel Y. A. & Cimbala J., "Fluid Mechanics -Fundamentals and Applications", 3/e, McGraw Hill Edition, 2013.
3. Modi P N and Seth, S M Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019).

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Civil Engineering

4. Robert W. Fox, Alan T. McDonald, Philip J. Pirtchard John W. Mitchell, Introduction to Fluid Mechanics, 9th Edition, Wiley Publications, 2015.

REFERENCE BOOKS:

1. 1. R K Rajput, "A Text Book of Fluid Mechanics and Hydraulic Machines", 6th edition, S. Chand, 2015.
2. Donald F. Elger, Barbara C. Williams, Clayton T. Crowe, John A. Roberson, Engineering Fluid Mechanics, John Wiley & Sons, 10th Edition, 2013.
3. V L Streeter, Fluid Mechanics, McGraw Hill Book Co., 2010.
4. White F M., "Fluid Mechanics", 7/e, McGraw Hill Edition, 2010.
5. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.

WEB RESOURCES:

1. https://ekumbh.aicte-india.org/allbook.php#
2. https://books.google.co.in/books?id=0clZbfwgiyUC&printsec=copyright&redir_esc=y#v=onepage&q&f=false
3. https://www.slideshare.net/slideshow/r-k-bansal-a-textbook-of-fluid-mechanics-and-hydraulic-machines-9laxmipdf/255316731
4. https://civil.aitmbgm.ac.in/wp-content/uploads/2023/01/Fluid-Mechanics-Fluid-Machines.pdf
5. https://ggnindia.dronacharya.info/Downloads/Sub-info/RelatedBook/5thSem/FLUID-MACHINES-REFERENCE-BOOK-2.pdf
6. https://nptel.ac.in/courses/112104118
7. https://archive.nptel.ac.in/courses/112/104/112104117/#

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105101082
2. https://onlinecourses.nptel.ac.in/noc22_ce85/preview
3. https://archive.nptel.ac.in/courses/112/105/112105287/
4. https://archive.nptel.ac.in/courses/112/105/112105171/
5. https://archive.nptel.ac.in/courses/112/105/112105206/

OUTCOMES

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

1. Apply and demonstrate the fundamental properties of fluids, pressure measurement techniques, buoyancy and the stability of floating bodies. (K3)

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Meeting No. 9 Dated: 04/3/2025

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2. Understand different types of fluid motion and apply continuity, momentum, and energy equations to solve real-world flow problems. (K3)
3. Apply Darcy–Weisbach equation to compute losses in pipes for both laminar and turbulent flows and apply boundary layer theory in flow analysis. (K3)
4. Analyze and interpret fluid flow models by applying the principles of dimensional analysis and similitude to engineering applications.(K4)
5. Evaluate and compare the performance of differnt hydraulic turbines by constructing and interpreting velocity triangles. (K5)
6. Analyze the performance of centrifugal and reciprocating pumps by interpreting key metrics such as head, efficiency and power requirements. (K4)

CO – PO, PSO MAPPING:

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

SEMESTER - III

24MEPC302 112105206 SDG NO. 4,8,9,12	ENGINEERING METALLURGY	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To introduce students to the basic structure of alloys and phase diagrams.
- To help students understand the purpose and process of heat treatment.
- To explain advanced case hardening techniques.
- To explore the properties and applications of ferrous and nonferrous metals.
- To provide an understanding of ceramic materials and composites.
- To teach students about strengthening mechanisms and material testing.

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MODULE - I ALLOYS AND PHASE DIAGRAMS 8

Constitution of alloys– Solid solutions, substitutional and interstitial–phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel and cast Iron - microstructure, properties and application.

Plastic Deformation: Dislocations and Deformations by Slip, Twinning, Stacking faults. Dislocation Theory.

MODULE - II HEAT TREATMENT - INTRODUCTION 7

Definition - Full annealing, stress relief, recrystallisation and spheroidising – normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR.

MODULE - III HEAT TREATMENT - CASE HARDENING 7

Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.

MODULE - IV FERROUS AND NONFERROUS METALS & NON METALLIC MATERIAL-POLYMER 8

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels– HSLA, Maraging steels– Cast Iron-Grey, white, malleable, Spheroidal – alloy cast irons, Copper and copper alloys Cupronickel–Aluminium and Al-Cu –precipitation strengthening treatment–Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA,PET,PC, PA,ABS, PI,PAI, PPO,PPS, PEEK, PTFE,Polymers – Urea and Phenol formaldehydes.

MODULE - V NON METALLIC MATERIALS - CERAMICS 7

Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites- Classifications- Metal Matrix and FRP - Applications of Composites.

MODULE - VI MECHANICAL METALLURGY AND TESTING OF MATERIALS AND STRENGTHENING MECHANISMS 8

Strengthening Mechanisms: Cold working, Grain size control, precipitation strengthening, dispersion strengthening, particulate and fiber strengthening, texture strengthening.

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Fracture: Types, Griffith's theory of brittle fracture. Testing of Materials - Tension, Torsion, Shear, Delamination, Hardness, Impact, fatigue and Creep Testing of materials according to ASTM Standards.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company,1997.
2. Williams D Callister, "Material Science and Engineering", Wiley India Pvt Ltd, Revised Indian Edition 2014.

REFERENCES:

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials",Prentice Hall of India Private Limited, 2010.
2. R.K.Rajput, " Engineering Materials and Metallurgy", S.Chand& Co
3. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd., 2015.
4. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012
5. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering",Viva Books Pvt. Ltd., New Delhi, 2006

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/108/112108150/
2. https://nptel.ac.in/courses/113/106/113106032/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/122/102/122102008/
2. https://nptel.ac.in/courses/113/102/113102080/
3. https://nptel.ac.in/courses/113/104/113104074/
4. https://nptel.ac.in/courses/112/104/112104219/
5. https://nptel.ac.in/courses/113/105/113105028/
6. https://nptel.ac.in/courses/113/106/113106075/
7. https://nptel.ac.in/courses/112/104/112104220/

OUTCOMES

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

1. Interpret the concept of binary phase diagrams, reactions terminologies associated with metallurgy and also able to describe the microstructure of steel and cast iron. (K3)

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2. Apply the suitable heat treatment processes for a specific requirement and demonstrate the hardenability tests on steel. (K3)
3. Construct the appropriate case hardening processes in the heat treatment of steel and enumerate the impact of alloying elements on the properties and applications of ferrous and non-ferrous metals in the broader engineering context. (K3)
4. Classify the properties and applications of the ferrous and non-ferrous and non-metallic materials (polymers) for suitable engineering applications. (K3)
5. Classify the properties and applications of the non-metallic materials (Ceramics and composites) for suitable engineering applications. (K3)
6. Illustrate the various plastic deformation mechanisms and its effect on mechanical properties and also able to test the mechanical properties of materials. (K4)

CO – PO, PSO MAPPING:

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

SEMESTER - III

24MEPW301 112107144 SDG NO. 4,7,12,15	MANUFACTURING PROCESS WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To impart foundational knowledge on metal casting processes
- To familiarize students with various metal joining techniques
- To provide a comprehensive understanding of metal forming techniques
- To develop competency in sheet metal fabrication
- To explore the processing and moulding of plastic components
- To introduce composite materials and their classifications

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MODULE - I METAL CASTING PROCESSES **8**

Sand Casting: Sand Mould - Type of patterns - Pattern Materials - Pattern allowances - Moulding sand Properties and testing - Cores -Types and applications - Moulding machines - Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes: Defects in Sand casting.– Testing and inspection of castings.

MODULE - II JOINING PROCESSES **8**

Operating principle, basic equipment, merits and applications of fusion welding processes: Gas welding - Types - Flame characteristics; Manual metal arc welding - Gas Tungsten arc welding - Gas metal arc welding - Submerged arc welding ,Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects:

MODULE - III METAL FORMING PROCESSES **8**

Hot working and cold working of metals - Forging processes -. Rolling of metals- Types of Rolling - - Defects in rolled parts. Principle of rod and wire drawing - Tube drawing - Principles of Extrusion - Types - Hot and Cold extrusion

MODULE - IV SHEET METAL PROCESSES **7**

Sheet metal characteristics - shearing, bending and drawing operations - Stretch forming operations - Metal spinning, Formability of sheet metal - High Energy Rate Forming processes: Explosive forming- Electro hydraulic forming,

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

Introduction - Types and characteristics of plastics - Moulding of thermoplastics - working principles and typical applications - injection moulding - Plunger and screw machines - Compression moulding, Transfer Moulding.

MODULE - VI INTRODUCTION TO COMPOSITE MATERIALS **7**

Definition-Matrix -polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers- fiber fabrication-natural composite - Advantages and drawbacks of composites.

LIST OF EXPERIMENTS

1. Basic melting and casting process.
2. Welding and cutting
3. Determination of power consumption in sheet rolling process
4. ~~Ericson cupping test~~

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5. Preparation of composite material
6. Construction of FLD of sheet metal.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Stir Casting machine -1 No
2. Gas Welding set up - 1 No
3. Two High roll Mill- 1 No
4. Ericson cupping tester- 1 No

TOTAL: 60 PERIODS

TEXT BOOKS:

1. A Textbook of Manufacturing Technology: Manufacturing Processes - R. K. Rajput
2. HajraChouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", Volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008.
3. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013.

REFERENCES:

1. P. N. Rao, Manufacturing Technology (Volume 1) – Foundry, Forging and Welding, 4th Edition, Tata McGraw Hill Education, New Delhi, 2013.
2. 2. Mikell P. Groover, Fundamentals of Modern Manufacturing Materials, Processes and Systems, Publishers: Wiley India, 2012

WEB REFERENCES:

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

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/107/112107083/
2. https://onlinecourses.nptel.ac.in/noc23_me90/preview
3. https://onlinecourses.nptel.ac.in/noc19_me52/preview
4. https://www.classcentral.com/course/youtube-mechanical-manufacturing-processes-i-47654

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OUTCOMES

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

1. Classify various casting processes and its inspection methods. (K3)
2. Demonstrate various joining processes and interpret their defects. (K3)
3. Exhibit various metal forming processes. (K3)
4. Classify various processing methods for sheet metal works. (K3)
5. Classify various types of plastics based on moulding methods. (K3)
6. Illustrate the carious composite fabrication methods. (K3)

CO – PO, PSO MAPPING:

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

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:

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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

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

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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.

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

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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

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)

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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)

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

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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

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

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GENERAL AWARENESS **4**

GA 1 General Knowledge 4

NAVAL ORIENTATION 6

AF 1 Armed Forces and Navy Capsule 3

EEZ 1 EEZ Maritime Security and ICG 3

ADVENTURE 1

AD 1 Introduction to Adventure Activities 1

BORDER & COASTAL AREAS **2**

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

TOTAL: 45 PERIODS

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

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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

SEMESTER - III

24MEPL301 - SDG NO. 4,6,9,14	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To make the students understand and interpret drawings of machine components.
- To prepare assembly drawings both manually and using standard CAD packages.
- To familiarize the students with Indian Standards on drawing practices and standard components.
- To gain practical experience in handling 2D drafting.

LIST OF EXPERIMENTS:

1. Study of Introduction to Machine Drawing.
2. Study of BIS specifications– Welding symbols, riveted joints, keys, Fasteners.
3. Study of Limits, Fits of individual dimensions.
4. Study of Basic principles of geometric dimensioning & tolerance.
5. 2D assembly drawing of Screw Jack.
6. 2D assembly drawing of Plummer Block.
7. 2D assembly drawing of Flange Coupling.
8. 2D assembly drawing of Universal Coupling.
9. 2D assembly drawing of Knuckle Joint.
10. 2D assembly drawing of Gib & Cotter Joint.
11. 2D assembly drawing of Sleeve & Cotter Joint.
12. 2D assembly drawing of Engine Piston.

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13. 2D assembly drawing of Connecting Rod.
14. 2D assembly drawing of Lathe Tailstock.
15. 2D assembly drawing of Stuffing Box.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No	List of Equipment	Qty.
1	Pentium IV computer or better hardware, with suitable graphics facility.	30
2	Licensed Software for 2D Drafting and 3D Modeling	30
3	LASER Printer	1

TOTAL : 45 PERIODS

OUTCOMES

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

1. Interpret BIS standards, welding symbols, riveted joints, fasteners, fits, and geometric tolerances to create technically accurate machine drawings (K3).
2. Develop detailed 2D assembly drawings of mechanical components and subassemblies such as screw jack, flange coupling, piston, and connecting rod using conventional drawing practices (K3).

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	-	-	3	-	-	-	2	-	2	-	3
Co2	-	-	2	-	3	-	-	-	2	-	2	-	3

SEMESTER - III

24METP301 - 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.

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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

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

OBJECTIVES:

- Understand team building and acquire leadership skills.
- Gain Scouting spirit.
- Familiarize with the standards relevant to MECH.

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

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MODULE - II RANGER AND ROVER **10**

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

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

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

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

Activating the Earth Tribe Initiative in your Community.

MODULE - IIIINTRODUCTION 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

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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 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

24ECID301 - SDG NO. 4,11,15	INNOVATIVE DESIGN LAB - I	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To provide opportunities for students to develop an entrepreneurial mindset and explore real-world problem-solving through a startup-centric approach.
- To enable hands-on experience in identifying market needs
- To enable development of skill sets for designing, validating, and realizing a Minimum Viable Product (MVP) for an entrepreneurial venture.

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- 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.

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)

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

CO – PO, PSO MAPPING:

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

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SEMESTER - IV

24MEPC401 112103316 SDG NO. 4,7,9,13	THERMAL ENGINEERING	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the basics of Power Producing and Power consuming thermal system and their functioning.
- To apply above basics for the analysis and design of such systems.

MODULE - I GAS POWER CYCLES **8**

Air standard cycles, Otto cycle, Diesel cycle, Dual cycle and Brayton cycle, efficiency, mean effective pressure. Performance analysis of cycles.

MODULE- II AIR SYSTEMS **7**

Compressor, fans and blowers; rotary and reciprocating. Their types, classification and functioning. Single and multi-stage compressor. Performance calculation and power consumption for compressor.

MODULE - III I.C. ENGINES **8**

S.I. Engine and C.I. Engines. Two and Four stroke Engines, Valve timings, Components of Engines. Auxiliary Systems such as air system, cooling system, lubrication system, fuel system, lubricating system etc. of S.I. and C.I. Engines, Super-charging, Carburettor and Fuel Engine System, Governing and performance analysis of engines.

MODULE- IV BOILERS AND COGENERATION **7**

Boilers its types, power and process boilers, its accessories and mountings, functioning of various accessories. Cogeneration.

MODULE- V STEAM TURBINE **8**

Nozzle and diffusers, their function, pressure ratio, Steam Turbines, Types, Impulse and reaction principles, construction of steam turbine, Velocity diagrams, Work done and efficiency calculation, optimal operating conditions. Multi-staging, compounding and governing.

MODULE - VI REFERIGERATION AND AIRCONDITIONING **7**

Vapor compression and vapor absorption refrigeration cycle, Performance calculation, Effect of superheat and sub-cooling, working principle of air cycle, and concept of RSHF, GSHF and ESHF, Cooling load calculations. Components

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of air conditioning systems and working principle of summer and winter air conditioning.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rajput. R. K., "Thermal Engineering", S. Chand Publishers, 2017.
2. Rudramoorthy R., "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003.
3. Nag P.K, "Power Plant Engineering", Tata McGraw-Hill, New Delhi, 1st edition, 2002.

REFERENCES:

1. I Kothandaraman. C.P., Domkundwar. S, Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition, DhanpatRai& sons , 2016.
2. Arora C. P. "Refrigeration and Air Conditioning", Tata McGraw-Hill, 2008.
3. Ganesan V., "Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill 2012.
4. Ramalingam K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
5. Sarkar B.K, "Thermal Engineering", Tata McGraw-Hill Publishers, 2007.

WEBRESOURCES:

1. https://nptel.ac.in/courses/112/106/112106133/
2. https://nptel.ac.in/courses/112/105/112105129/

ONLINERESOURCES:

1. https://nptel.ac.in/courses/112/107/112107216/
2. https://nptel.ac.in/courses/112/107/112107291/
3. https://nptel.ac.in/courses/112/103/112103277/
4. https://nptel.ac.in/courses/112/103/112103275/
5. https://nptel.ac.in/courses/112/107/112107208/
6. https://nptel.ac.in/courses/112/105/112105128/

OUTCOMES

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

1. Analyze different air power cycles. [K3]
2. Illustrate knowledge and applications to different reciprocating compressor. [K3]

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3. Differentiate types of IC Engines and their parts, their need, and functioning of the engine and its performance analysis. [K3]
4. Compare different types of boilers for thermal power generation. [K3]
5. Illustrate the performance of steam turbine and its function.[K3]
6. Analyze performance of different types of air conditioning systems. [K3]

CO – PO, PSO MAPPING:

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

SEMESTER - IV

24MEPC402 112104250 SDG NO. 4,8,9,12,16	METROLOGY AND MEASUREMENTS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To introduce the fundamentals of metrology
- To provide knowledge on angular measurement techniques
- To develop understanding of form and surface measurement
- To impart knowledge on laser-based metrology systems
- To enable students to measure mechanical parameters
- To familiarize students with advanced metrology tools

MODULE - I BASICS OF METROLOGY 7

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards - Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly.

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MODULE- II ANGULAR MEASUREMENTS 7

Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

MODULE- III FORM MEASUREMENT 7

Thread Measurement – Measurement of effective diameter using Two wire and Three wire method - Principles and Methods of straightness – Flatness measurement – Surface finish measurement, Roundness measurement – Applications.

MODULE - IV LASER IN METROLOGY 8

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment.

MODULE -V MEASUREMENT OF POWER, FLOW AND TEMPERATURE 8

Force, torque, power - mechanical, Pneumatic, Hydraulic, and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer.

MODULE- VI ADVANCES IN METROLOGY 8

Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Jain R.K. "Engineering Metrology", Khanna Publishers, 2005.
2. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

REFERENCES:

1. Alan S. Morris, "The essence of Measurement", Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2014.
3. Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA,1990.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.

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5. Raghavendra ,Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/106/112106139/
2. 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/

OUTCOMES

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

1. Apply the knowledge of metrology and classify the types of errors that occur in measurements, explaining their impact on precision, accuracy, and interchangeability. (K3)
2. Demonstrate the working principles and applications of angular measuring instruments such as bevel protractors, sine bars, autocollimators, and clinometers. (K3)
3. Apply different methods to measure thread dimensions, straightness, flatness, surface finish, and roundness. (K3)
4. Apply laser interferometry for straightness and alignment measurements. (K3)
5. Compare mechanical, pneumatic, hydraulic, and electrical methods of force, torque, and power measurement. (K3)
6. Apply the working principles of Coordinate Measuring Machines (CMM) and Machine Vision Systems to illustrate their applications in engineering measurement. (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	-
CO2	3	-	-	-	3	-	-	-	-	-	-	3	3
CO3	3	-	-	3	3	-	-	-	-	-	-	-	3
CO4	3	-	-	3	3	-	-	-	-	-	-	-	3
CO5	3	3	-	-	3	-	-	-	-	-	-	3	3
CO6	3	-	-	-	3	-	-	-	-	-	3	3	3

SEMESTER - IV

24MEPC403 112105268 SDG NO. 4,9,12	THEORY OF MACHINES	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the principles in the formation of mechanisms and their kinematics.
- To learn the basic concepts of toothed gearing and kinematics of gear trains.
- To study the types of Cams & Followers and to draw the Cam Profile based on the follower motion.
- To analyze the forces and torque acting on Reciprocating Engines and Balancing of Rotating & Reciprocating masses.
- To know the concepts of vibration and the related parameters.
- To examine the effect of friction in different machine elements and to understand the principle of stability control.

MODULE - I BASICS OF MECHANISMS AND KINEMATICS 7

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of Freedom, Mobility, Kutzbach criterion, Gruebler's criterion (Definitions only) – Grashof's Law - Kinematic inversions of four-bar chain and slider crank chains. Relative Velocity method (Graphical Method) for the Velocity and Acceleration analysis of Four bar chain and Single slider Mechanisms.

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MODULE - II GEARS AND GEAR TRAINS 7

Types of Gears - Law of gearing (Definition only) - Spur Gear terminology – Involute and Cycloidal tooth profiles – Problems on Length of path of Contact and Arc of Contact - Contact ratio and Interference.(No derivations) Gear trains – Speed ratio, train value – Parallel axis gear trains.

MODULE - III KINEMATICS OF CAM 7

Classification of Cams and Followers – Terminology and definitions – Displacement diagrams –Uniform velocity, Simple harmonic, Parabolic and Cycloidal motions- Layout of plate cam profiles with Reciprocating Followers - Pressure angle.

MODULE - IV FORCE ANALYSIS AND BALANCING OF FORCES 8

D- Alembert's principle – Dynamic force Analysis in reciprocating engines. Static and dynamic balancing– Balancing of Rotating and Reciprocating masses – Balancing of masses rotating in same and different planes - Balancing of Single cylinder and Four-cylinder inline Engines.

MODULE - V FREE AND FORCED VIBRATIONS 8

Basic features of vibratory systems – Free vibration– Equations of motion (Definitions only)- Dunkerley's method - Natural frequency-Critical speed of shafts. Free Damped vibration, Types of Damping (Definitions only)–Logarithmic decrement-Damping factor. Forced, Damped Vibration - Periodic Harmonic forcing – Amplitude of Vibration & Transmissibility.

MODULE - VI FRICTION ELEMENTS AND CONTROL MECHANISMS 8

Friction in screw threads (Definitions only)– Screw Jack – Pivot and Collar Bearings – Flat & V-Belt drives. Gyroscopic forces and couples - Gyroscopic effects in Aeroplanes and Ships.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 3rd Edition, Oxford University Press, 2009.
2. Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2020.
3. Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2019.

REFERENCES:

1. V.P.Singh,"Mechanical Vibrations", Dhanpat Rai & Co (p) Ltd., New Delhi, 2015

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2. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.
4. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
6. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961.
7. Thomas Bevan, "Theory of Machines",3rd Edition, CBS Publishers and Distributors, 2005.
8. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005.

WEB REFERENCES:

1. http://www.mekanizmalar.com
2. http://www.mechanisms.com
3. http://dynref.engr.illinois.edu

ONLINE RESOURCES:

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

OUTCOMES

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

1. Illustrate the basic principles in the formation of simple mechanisms and apply its kinematics (K3)
2. Determine the working parameters of Gears and Kinematics of Gear trains by knowing the types, Terminologies of Gears and Gear trains (K3)
3. Construct the Cam Profile, according to Follower motion relating to the types of Cams & followers based on application. (K3)
4. Compute the forces acting on the parts of an I.C Engine considering Inertia force and balance the unbalance forces in Rotating & Reciprocating masses. (K3)
5. Calculate the various parameters of Vibration through the concepts and equations on types of vibrating systems (K3)
6. Demonstrate the effect of friction on various machine elements and use the gyroscopic principles for stability control of vehicles. (K3)

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CO – PO, PSO MAPPING:

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

SEMESTER - IV

24CEPC405 105104160 SDG NO. 4, 9	STRENGTH OF MATERIALS	L	T	P	CP	C
		3	1	0	5	4

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.

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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.

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://nite.ac.in/index.php/?url=users/view/270/12/3

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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)
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

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SEMESTER - IV

24MEPW401 112105233 SDG NO. 9, 11, 12	MACHINE TOOL TECHNOLOGY WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To provide fundamental knowledge of metal cutting principles
- To familiarize students with various turning machines
- To impart understanding of shaper, milling, drilling, and gear cutting operations
- To introduce abrasive machining and broaching processes
- To develop competency in CNC machining and part programming
- To expose students to unconventional machining methods

MODULE - I THEORY OF METAL CUTTING 8

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools– nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

MODULE- II TURNING MACHINES 8

Centre lathe, constructional features, specification, operations — taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout — automatic lathes: semi –automatic — single spindle : Swiss type, automatic screw type — multi spindle

MODULE - III SHAPER, MILLING AND GEAR CUTTING MACHINES 8

Shaper — Types of operations. Drilling,reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting — forming and generation principle and construction of gear milling, hobbing and 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

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MODULE-V CNC MACHINING 7

Numerical Control (NC) machine tools — CNC types, constructional details, special features, machining centre, part programming fundamentals CNC — manual part programming — micromachining — wafer machining.

MODULE-VI UNCONVENTIONAL MACHINING PROCESSES 7

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, UltrasonicMachining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish,tool wear, dielectric, power and control circuits, wire EDM; Electrochemical machining (ECM), etchant &masking, process parameters, MRR and surface finish.Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron BeamMachining.

LIST OF EXPERIMENTS

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Helical Gear Cutting in milling machine
4. Gear generation in hobbing machine
5. Gear generation in gear shaping machine
6. Plain Surface grinding
7. Cylindrical grinding
8. Tool angle grinding with tool and Cutter Grinder
9. Measurement of cutting forces in Milling / Turning Process
10. CNC Part Programming

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Turret and Capstan Lathes – 1 No each.
2. Horizontal Milling Machine – 2 Nos.
3. Vertical Milling Machine – 1 No.
4. Surface Grinding Machine – 1 No.
5. Cylindrical Grinding Machine – 1 No.
6. Radial Drilling Machine – 1 No.
7. lathe Tool Dynamometer– 1 No.
8. Milling Tool Dynamometer – 1 No.
9. Gear Hobbing Machine – 1 No.
10. Tool Makers Microscope – 1 No.
11. CNC Lathe – 1 No.
12. CNC Milling machine – 1 No.

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13. Gear Shaping machine – 1 No.
14. Centreless grinding machine – 1 No.
15. Tool and cutter grinder – 1 No.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. A. Ghosh and A. K. Mallik, Manufacturing Science, East West Press, Second Edition, 2010.
2. Mikell P. Groover, Fundamentals of modern manufacturing: materials, processes, and systems. John Wiley & Sons, 2010.
3. P N Rao, Manufacturing Technology Vol 2, 4th Edition. Tata Mc Graw Hill Publishers.2018

REFERENCES:

1. Production Technology HMT, Tata McGraw Hill, 2001.
2. M. C. Shaw, Metal Cutting Principles, Second Edition, Oxford University Press, 2005.
3. P. K. Mishra, Nonconventional Machining, Narosa Publishing House, 2007
4. R.K. Jain., Production Technology, 17th Edition, Khanna Publishers, 2001.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc24_me48/preview
2. https://archive.nptel.ac.in/courses/112/107/112107219/
3. https://archive.nptel.ac.in/courses/112/104/112104204/

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-me05/
2. https://onlinecourses.nptel.ac.in/noc16_me17
3. https://archive.nptel.ac.in/courses/112/105/112105306/
4. https://onlinecourses.nptel.ac.in/noc24_me50/preview

OUTCOMES

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

1. Apply the principles of theory of metal cutting (K3)
2. Demonstrate the turning operations using turning machines. (K3)
3. Demonstrate shaping, drilling and milling processes. (K3)

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4. Classify various Abrasive and Broaching processes. (K3)
5. Demonstrate the programming methods in CNC machining. (K3)
6. Classify various unconventional machining processes. (K3)

CO – PO, PSO MAPPING:

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

SEMESTER - IV

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

ARMY WING

PERSONALITY DEVELOPMENT **9**

PD 3 Group Discussion: Team Work 2

PD 4 Career Counselling, SSB Procedure & Interview Skills 3

PD 5 Public Speaking 4

BORDER & COASTAL AREAS **4**

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

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

ARMED FORCES 3

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

COMMUNICATION **3**

C 1 Introduction to Communication & Latest Trends 3

INFANTRY **3**

INF 1 Organisation of Infantry Battalion & its weapons 3

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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

ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

BORDER & COASTAL AREAS **2**

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

TOTAL: 45 PERIODS

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

TOTAL :45 PERIODS

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SEMESTER - IV

24CEPL403 - SDG NO. 6,7,9,12,13	STRENGTH OF MATERIALS AND FLUID MECHANICS & MACHINERY LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To analyze the mechanical properties of materials through tensile, torsion, impact, hardness, and Deflection tests.
- To evaluate fluid flow characteristics by determining discharge coefficients, friction factors, and pump/turbine performances.

CYCLE - I - STRENGTH OF MATERIALS **30**

LIST OF EXPERIMENTS

1. Tensile Test on Mild Steel Rod Using Universal Testing Machine (UTM).
2. Double Shear Test Using Universal Testing Machine (UTM).
3. Torsion Test on Mild Steel Rod Using Torsion Testing Machine..
4. Hardness Testing of Metals Using Rockwell and Brinell Hardness Testing machines.
5. Tensile Test on Helical Spring.
6. Izod Impact Test on Mild Steel specimen.
7. Charpy Impact Test on Mild Steel specimen.
8. Deflection Test on Beams (Cantilever and Simply Supported Beams).
9. Measurement of strain Using Strain Gauge.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No	List of Equipment	Qty.
1	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7	Strain measuring Instrument using Rosette Strain Gauge	1

CYCLE - II - FLUID MECHANICS AND MACHINERY **30**

LIST OF EXPERIMENTS

1. Determination of Coefficient of Discharge for a Venturi Meter.
2. Determination of Coefficient of Discharge for an Orifice Meter.

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3. Determination of Friction Factor in a Pipe System.
4. Performance Analysis and Characteristic Curves of a Gear / Vane Pump.
5. Performance Analysis and Characteristic Curves of a Reciprocating Pump.
6. Performance Analysis and Characteristic Curves of a Centrifugal Pump/Submersible Pump.
7. Performance Analysis and Characteristic Curves of Hydraulic Turbines (Pelton Wheel and Francis Turbines).

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No	List of Equipment	Qty.
1.	Orifice meter setup	1
2.	Venturi meter setup	1
3.	Pipe Flow analysis setup	1
4.	Gear pump setup	1
5.	Reciprocating pump setup	1
6.	Centrifugal pump/submersible pump setup	1
7.	Hydraulic Turbine (Pelton Wheel, Kaplan, and Francis Turbines).	1

TOTAL: 60 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 and compare the elastic constants such as Young's modulus and Rigidity modulus of the given specimen through Deflection testing and spring testing with standard values. (K3)
3. Measure the flow rate of fluid using different flow measuring devices and calculate the friction loss and other minor losses in a pipe flow. (K3)
4. Predict the basic performance characteristics of hydraulic Pumps and Turbines. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	-	2	-	-	-	-	-	-	-	2	2
CO2	2	-	-	2	-	-	-	-	-	-	-	2	2
CO3	2	-	-	2	-	-	-	-	-	-	-	2	2
Co4	2	-	-	2	-	-	-	-	-	-	-	2	2

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SEMESTER - IV

24MEPT401 - SDG NO. 4,6,9,14	DYNAMICS & METROLOGY LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- To gain knowledge in use and calibration of Vernier calipers, micrometers, height gauges, depth micrometers, bore gauges, telescopic gauges, and comparators.
- To gain practical knowledge about Dynamics of various mechanisms & to find physical properties of masses like Radius of gyration and Moment of Inertia etc.,
- To understand how certain measuring devices are used for dynamic testing.
- To measure various parameters accurately using different measuring instruments for Quality Inspection in Industries.
- To identify and classify different measuring tools and explain accuracy and precision

MODULE - I LINEAR MEASUREMENTS **2+8**

Vernier Caliper and its types – Micrometer – Vernier Height Gauge – Depth Micrometer – Bore Gauge – Telescopic Gauge – Comparators.

LIST OF EXPERIMENTS:

1. Calibration and use of Vernier Caliper – using gauge blocks
2. Calibration and use of Micrometer - using gauge blocks
3. Calibration and use of Vernier Height Gauge - using gauge blocks
4. Calibration and use of depth Micrometer.
5. Calibration and use of Bore Gauge.
6. Calibration and use of Telescopic Gauge.
7. Measurement of linear dimensions using Comparators.
8. Measurement of angles using Sine Bar.

MODULE - II THREAD MEASUREMENTS **2+8**

Introduction - Thread measurement and its types.

LIST OF EXPERIMENTS:

1. Non-contact (Optical) measurement using Toolmaker's microscope.
2. Non-contact (Optical) measurement using Profile projector.

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3. Measurement of screw thread parameters using Screw thread Micrometers.
4. Measurement of screw thread parameters using a floating Carriage Micrometer.

MODULE - III GEAR MEASUREMENT & MEASUREMENT USING SENSORS **2+8**

Gear measurement and its types. Types of sensors used in measurement.

LIST OF EXPERIMENTS:

1. Measurement of gear parameters using Gear Tooth Vernier Caliper.
2. Measurement of Force using Load Cell.
3. Measurement of Torque.
4. Measurement of Temperature using Thermocouple.

MODULE - IV MASS MOMENT OF INERTIA AND CAM **2+8**

Determination of Mass moment of inertia-Kinematics of Eccentric Cam

LIST OF EXPERIMENTS:

1. Determination of Mass Moment of Inertia using Compound pendulum.
2. Determination of Mass moment of inertia of Connecting Rod with Fly wheel.
3. Determination of Mass moment of inertia and Centrifugal force of the sliding masses, using the Turn Table apparatus.
4. Determination of Mass Moment of Inertia using bifilar suspension.
5. Determination of Mass Moment of Inertia using Trifilar suspension.
6. Eccentric Cams – Motion curves and study of jump phenomenon.

MODULE - V FREE VIBRATION - TORSIONAL VIBRATION - FORCED VIBRATION **2+8**

Free Transverse Vibration-Natural frequency-Critical speed of shafts - Torsional vibration –Forced Vibration- Transmissibility

LIST OF EXPERIMENTS:

1. Single degree of freedom Spring Mass System – Determination of natural frequency.
2. Transverse vibration of Cantilever beam.
3. Transverse vibration of Simply supported beam.
4. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
5. Determination of Torsional natural frequency of single Rotor system – Undamped.

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6. Determination of Torsional natural frequency of Double Rotor systems – Undamped.
7. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
8. Determination of transmissibility ratio using vibrating table.

MODULE - VI CENTRIFUGAL GOVERNORS AND GYROSCOPIC EFFECTS **2+8**

Governors– Gravity controlled governors-Porter and Proell Governors-Effect of Gyroscopic forces and couples on spinning disc-Balancing of rotating masses and reciprocating masses.

LIST OF EXPERIMENTS:

1. Determination of range of speed of Watt Governor.
2. Determination of range of speed of Porter Governors.
3. Determination of range of speed of Proell Governors.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Balancing of rotating masses.
6. Balancing of reciprocating masses.

TOTAL : 60 PERIODS

OUTCOMES

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

1. Determine mass moment of inertia of mechanical elements, Natural frequency of Longitudinal, Transverse & Torsional Undamped Vibration and Critical speed of shafts.(K3)
2. Study the governor effect & range, gyroscopic effect on Disc and Balancing of masses. (K3)
3. Find out the various linear, angular measurements , various profiles of small mechanical components using light illumination devices various and physical & dynamic properties like Tolerance, force , temperature using LVDT, Load cell and Thermocouples. (K3)

CO – PO, PSO MAPPING:

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

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SEMESTER - IV

24METP401 - SDG NO. 4	APTITUDE SKILLS - II	L	T	P	CP	C
		0	0	2	2	0

PROBLEM SOLVING TECHNIQUES USING C PROGRAMMING – PHASE 1

OBJECTIVES:

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

MODULE - I FOUNDATIONS OF PROGRAMMING 12

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

MODULE - II DATA TYPES, NUMBER SYSTEMS, AND FUNCTIONS 12

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

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

- Pointers in C:

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- 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

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.

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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

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

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OUTCOMES

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

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

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

24MEID401 - 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.

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- 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.
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)

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Board of Studies of MECH dept. 117
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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)
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

Recommended by
Board of Studies of MECH dept.
Meeting No. 9 Dated: 21.3.25

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SEMESTER V

COURSE CODE: 24MEPC501	HEAT TRANSFER	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108106191	SYLLABUS VERSION 1.1	SDG NO. 4, 9, 11, 12, 13, 15				
PRE-REQUISITE COURSES	24MEPC301, 24MEPC401					

OBJECTIVES:

- To understand the mechanism of heat transfer in steady and transient heat conduction.
- To learn the heat transfer process through extended surfaces.
- To understand the mechanisms of heat transfer under free and forced convection and radiation.
- To impart the knowledge on phase change heat transfer.
- To perform thermal analysis and sizing of heat exchangers

MODULE - I FUNDAMENTALS AND CONDUCTION HEAT TRANSFER 8

Flux and driving potential for heat transfer -Applications - Modes of heat transfer- conduction, convection, radiation – Laws and calculation of rate of heat transfer - General differential equation of Heat Conduction– Cartesian and Polar Coordinates – One dimensional steady state heat conduction - plane and composite systems – Conduction with internal heat generation.

MODULE - II EXTENDED SURFACES AND TRANSIENT HEAT CONDUCTION 7

Extended surfaces – need and applications - Long fin, short fin with different boundary conditions - fin efficiency and effectiveness analysis. Unsteady heat conduction – Lumped parameter analysis – Semi infinite and infinite solids –Use of Heisler's charts.

MODULE - III RADIATION HEAT TRANSFER 8

Emission characteristics and laws of Black body radiation – Stefan Boltzmann law - Kirchhoff's law of radiation, Planck law, Wien's displacement law,– concept of shape factor – Grey body radiation –Radiation exchange between surfaces - Electrical Analogy – Radiation shields, Radiation through gases.

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MODULE - IV CONVECTION HEAT TRANSFER 8

Free and Forced Convection Heat Transfer- Hydrodynamic and Thermal Boundary Layer - Dimensionless numbers and Empirical correlations - Free and Forced Convection in external flow over plates, cylinders and spheres - Internal flow through tubes.

MODULE - V BOILING AND CONDENSATION 7

Boiling - Different regimes of boiling- Pool boiling, Nucleate boiling, Transition and Film boiling - correlations for boiling heat transfer.

Condensation- Film-wise and drop-wise condensation - Nusselt's theory of condensation on a vertical plate- correlations for condensation heat transfer.

MODULE - VI HEAT EXCHANGERS 7

Classification of Heat Exchangers- Parallel flow, Counter flow, and Cross flow heat exchangers - Overall Heat Transfer Coefficient –Fouling Factors - Concepts of LMTD and NTU -Analysis of Heat Exchangers – LMTD method - NTU method. Applications of heat exchangers - phase change Heat exchangers

TOTAL : 45 PERIODS

TEXT BOOK:

1. Yunus A. Cengel, Heat Transfer: A Practical Approach, Tata McGraw Hill, 2019.
2. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International Publishers, 2017.

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 1998.
2. Venkateshan S.P., Heat Transfer, Ane Books, New Delhi, 2004.
3. Ghoshdastidar P.S., Heat Transfer, Oxford University Press, 2004.
4. Nag P.K., Heat Transfer, Tata McGraw Hill, New Delhi, 2002.
5. Holman J.P., Heat and Mass Transfer, Tata McGraw Hill, 2000.
6. Ozisik M.N., Heat Transfer, McGraw Hill Book Co., 1994.
7. Kothandaraman C.P., Fundamentals of Heat and Mass Transfer, New Age International, 1998.
8. Yadav R., Heat and Mass Transfer, Central Publishing House, 1995.

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WEB REFERENCES:

1. https://nptel.ac.in/courses/112/108/112108149/
2. https://nptel.ac.in/courses/112/104/112104159/

ONLINE RESOURCES:

1. Mod-01 Lec-01 Introduction to heat transfer
2. Lec 1: Application of convective heat transfer
3. https://ocw.mit.edu/
4. https://nptel.ac.in/courses/112105771/
5. https://nptel.ac.in/courses/112101097/
6. https://nptel.ac.in/courses/112/105/112105248/

OUTCOMES:

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

1. Calculate the heat transfer rate and temperature distribution in steady state heat conduction. [K3]
2. Determine the performance parameters of fins and heat transfer parameters in transient heat conduction applications. [K3]
3. Analyze radiation heat exchange between bodies and surfaces in solid and participating media. [K4]
4. Interpret heat transfer in convection among engineering systems. [K3]
5. Calculate basic boiling and condensation heat transfer parameters. [K3]
6. Design and Analyze heat exchangers in various thermal systems [K4]

CO - PO, PSO MAPPING:

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

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SEMESTER V

COURSE CODE: 24MEPC502	DESIGN OF MACHINE ELEMENTS	L	T	P	CP	C
		3	1	0	3	4
NPTEL CODE: 112105125	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11, 12				
PRE-REQUISITE COURSES	24ESCE201, 24CEPC405					

OBJECTIVES:

- To familiarize the various steps involved in the Design Process.
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To design machine components for static, impact and fatigue strength.
- To design fasteners, shafts, joints, couplings, keys, threaded fasteners riveted joints, welded joints and power screws. (Use of PSG Design Data book is permitted)

MODULE - I FUNDAMENTALS OF MACHINE DESIGN 7

Phases of design process – Factors influencing machine design – Selection of materials – Factor of Safety-Preferred numbers – Limits, Fits and tolerances – Normal, Bending, Shear and Combined stresses – Calculation of Principle Stresses for various load combinations - Eccentric loading – Curved beams.

MODULE - II FLUCTUATING STRESSES IN MACHINE COMPONENTS 7

Theories of Failure - Stress concentration – Fluctuating stresses – S-N Diagram - Endurance limit – Notch sensitivity - Goodman and Soderberg relationship, stresses due to combined loading.

MODULE - III SHAFTS AND COUPLINGS 8

Introduction – Design of shafts under combined loads – Critical speed – Design of keys, keyways and splines – Design of rigid and flexible couplings.

MODULE - IV PERMANENT AND TEMPORARY JOINTS 8

Rivet types, rivet materials, failures of riveted joints, Joint Efficiency, Boiler Joints, Lozenge Joints, Riveted Brackets, eccentrically loaded joints. Types of

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welded joints, Strength of butt and fillet welds, welded brackets with transverse and parallel fillet welds, eccentrically loaded welded joints. Design of Cotter and Knuckle joints. Threaded fasteners – Bolted joints including eccentric loading.

MODULE - V ENERGY STORING ELEMENTS AND I.C ENGINE COMPONENTS **8**

Types of springs, spring materials, stresses in helical coil springs of circular cross sections. Concentric springs; springs under fluctuating loads. Leaf Springs: Stresses in leaf springs, equalized stresses, nipping of leaf springs. Introduction to Belleville springs. Flywheels considering stresses in rims and arms for engines. Design of Connecting Rod.

MODULE - VI 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 hydrodynamic journal and thrust bearing design. Roller and Ball bearings - Types and their applications, static and dynamic load carrying capacities, equivalent bearing load, load life relationship; selection of deep groove ball bearings - selection of bearings subjected to cyclic loads and speeds; probability of survival.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Richard G. Budynas, and J. Keith Nisbett, "Shigley's Mechanical Engineering Design", McGraw- Hill Education, 10th Edition, 2015.
2. V. Bhandari, "Design of Machine Elements", 4th edition, Tata McGraw Hill, 2017.

REFERENCES:

1. Robert L. Norton "Machine Design – An integrated approach", Pearson Education, 5th edition 2018.
2. Spotts M.F., Shoup T.E "Design of Machine Elements", Pearson Education, 8th edition, 2019.
3. P.C. Gope, "Machine Design – Fundamental and Application", PHI learning private ltd, New Delhi, 2012.

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4. Robert C. Juvinall and Kurt M. Marshek, "Machine Component Design",Wiley India.
5. Jindal U.C. "Machine Design", Pearson Education, 1st Edition 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/105/112105125/
2. https://nptel.ac.in/courses/112/106/112106137/
3. http://nitc.ac.in/index.php/?url=users/view/270/12/3
4. https://www.machinedesignonline.com/,
5. https://www.classcentral.com/course/machine-design1-7404

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/105/112105124/

OUTCOMES:

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

1. Analyze design standards, material selection and static stress behavior in machine components. (K4)
2. Examine variable stresses and failure theories to interpret their effect on machine component design. (K4)
3. Interpret the dimensions of torque transmitting elements. (K4)
4. Investigate and compare the strength characteristics of mechanical joints including knuckle, cotter, bolted, riveted and welded joints. (K4)
5. Interpret and assess design parameters of springs and flywheel under static and dynamic loading conditions. (K4)
6. Identify and evaluate performance parameters for the selection of hydrodynamic and antifriction bearings. (K4)

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

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SEMESTER V

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

OBJECTIVES:

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

MODULE - I INTRODUCTION 5

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

MODULE - II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 5

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

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.

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

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

TOTAL : 30 PERIODS

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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6. www.drishtiias.com/gs-special/gs-special-polity/important-sources-of-the-indian-constitution
7. www.india.gov.in/my-government/constitution-india/constitution-india-full-text
8. http://legislative.gov.in/constitution-of-india

MOOC REFERENCES

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

OUTCOMES:

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

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

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CO - PO, PSO MAPPING:

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

SEMESTER V

COURSE CODE: 24MEPL501	HEAT TRANSFER AND IC ENGINES LABORATORY	L	T	P	CP	C
		0	0	4	4	2
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 12,				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To study the performance, combustion characteristics, and emission behavior of internal combustion engines under varying operating conditions.
- To analyze different heat transfer modes (conduction, convection, radiation) and evaluate heat transfer coefficients using experimental setups.
- To apply and analyze the performance of thermal systems such as heat exchangers, refrigeration, air conditioning systems, and compressors.

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LIST OF EXPERIMENTS:

IC Engines Experiments:

1. Performance test on single cylinder 4-stroke diesel engine (load test).
2. Performance and emission test on petrol engine.
3. Heat balance test on diesel engine.
4. Morse test on multi-cylinder engine.
5. Valve timing / port timing diagram of IC engine.
6. Determination of Flash and Fire point for the given fluid.
7. Determination of viscosity for the given fluid.
8. Study of Steam turbine & Boiler.

Heat Transfer Experiments:

1. Determination of thermal conductivity of insulating powder.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Thermal conductivity measurement by guarded plate method.
4. Heat transfer in forced convection apparatus.
5. Heat transfer in natural convection apparatus.
6. Heat transfer in pin fin apparatus (forced and natural)
7. Emissivity measurement using radiation apparatus.
8. Determination of Stefan-Boltzmann constant.
9. Heat exchanger performance (parallel flow and counter flow).
10. Performance test on Reciprocating Air compressor
11. Determination of COP of Refrigeration system.
12. Determination of COP of Air conditioning System.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No	List of Equipment	Qty.
1	I.C Engine – 2 stroke and 4 stroke model.	1 No
2	4-stroke Diesel Engine with Mechanical Loading	1 No
3	4-stroke Diesel Engine with Electrical Loading.	1 No
4	4-stroke Diesel Engine with Hydraulic Loading	1 No
5	Multi-cylinder Petrol Engine	1 No
6	Single cylinder Petrol Engine	1 No
7	Steam Boiler with turbine setup	1 No
8	Natural convection-vertical cylinder apparatus	1 No

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9	Forced convection inside tube apparatus	1 No
10	Insulating powder apparatus	1 No
11	Guarded Plate Apparatus	1 No
12	Stefan-Boltzmann Apparatus	1 No
13	Pin-fin apparatus	1 No
14	Emissivity measurement apparatus	1 No
15	Parallel/counter flow heat exchanger apparatus	1 No
16	Two stage reciprocating air compressor	1 No
17	Refrigeration Test Rig	1 No
18	Air-conditioning Test Rig	1 No
19	Flash & Fire point apparatus	1 No
20	Viscosity apparatus	1 No

OUTCOMES:

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

1. Apply experimental methods and analyze the performance and emission characteristics of IC engines. [K4]
2. Apply heat transfer principles and analyze experimental results to determine thermal properties and heat transfer coefficients. [K4]
3. Apply data analysis techniques to evaluate the performance of thermal systems such as heat exchangers, refrigeration, and air conditioning systems. [K3]
4. Analyse experimental data and prepare technical reports with engineering conclusions. [K3]

CO - PO, PSO MAPPING:

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

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SEMESTER V

COURSE CODE: 24MEPL502	CAD/ CAM LABORATORY	L	T	P	CP	C
		0	0	4	4	2
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To draw part and Assembly Diagrams of dimensional Components.
- To gain practical experience in handling 3D modeling software systems.
- To understand the concepts G and M codes and manual part programming.
- To understand the applications of various CNC machines and to expose students to modern CNC application machines.

LIST OF EXPERIMENTS:

1. Introduction of 3D Modelling software (Solid Works / Fusion 360).
2. Creation of 3D assembly model of following machine elements using 3D Modeling software:

a. Knuckle Joint
b. Flange Coupling
c. Plummer Block
d. Screw Jack
e. Lathe Tailstock
f. Universal Joint

LIST OF EXERCISES (CAM):

1. Develop CNC Program for simple Facing operation with its tool simulation.
2. Develop CNC Program for Step turning operation with its tool simulation.
3. Develop CNC Program for Tapper turning operation with its tool simulation.
4. Develop CNC Program for Multiple Facing and turning operation along with its tool simulation.
5. Develop CNC Program for Grooving and threading operation along with its tool simulation.

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6. Develop CNC Program for Boring operation along with its tool simulation.
7. Develop a manual CNC Program for Contour milling with simulation.
8. Develop CNC Program for Profile milling operation.
9. Develop CNC Program for Profile milling and circular pocket operation with simulation.
10. Develop CNC Program for profile milling and drilling operations using CAM Package.
11. Develop CNC Program for mirroring operations using CAM Package

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No	List of Equipment	Qty.
1	Pentium IV computer or better hardware, with suitable graphics facility	30
2	Licensed software for Drafting and Modeling	30
3	CNC Lathe Machine	1
4	CNC Milling Machine	1

OUTCOMES:

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

1. Create 3D model for the various components using modelling software. (K2)
2. Generate part programming on CNC lathe and CNC milling machine for given design. (K2)

CO - PO, PSO MAPPING:

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

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SEMESTER V

COURSE CODE: 24METP501	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: 24ECID501	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, 24MEID301, 24MEID401					

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: 24MEEL501	ALTERNATE FUELS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 1031077125	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11, 12, 13				
PRE-REQUISITE COURSES	-					

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

Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels – Alcohols, Biodiesel, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Biogas, Fuel standards – ASTM & EN.

MODULE - II BIO-DIESEL FUELS 8

Vegetable oils and their important properties. Fuel properties characterization. Methods of using vegetable oils – Blending, preheating, Transesterification and emulsification – Performance, combustion and emission characteristics in diesel engines. Third generation biofuels, Ternary and Quaternary fuels, Issues & limitation of using vegetable oils in IC engines

MODULE - III ALCOHOL FUELS 8

Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Issues & limitation in alcohols

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MODULE - IV GASEOUS FUELS 7

Biogas, Natural gas, LPG, Hydrogen – Properties, problems, storage and safety aspects. Methods of utilisation in engines. Performance, combustion and emission characteristics in engines. Issues & limitation in Gaseous fuels

MODULE - V SPECIAL AND SYNTHETIC FUELS 7

Different synthetic fuels, Merits, and demerits, Dual, Bi-fuel and Pilot injected fuel systems, Fuel additives – types and their effect on performance and emission characteristics of engines, Flexifuel systems, Ethers - as fuel and fuel additives, properties and characteristics.

MODULE - VI EMISSION CONTROL TECHNIQUES & EQUIPMENTS 8

EGR systems, glow plugs, thermal converters, Catalytic converters: classification, honey comb, 2-way, 3-way catalytic converters, Particulate filter, Selective catalytic reduction (SCR) systems, Fumigation, water injection, secondary air injection, enhanced evaporative emission control system (EVAP). testing equipment- Exhaust gas analyzer, Orsat apparatus, NDIR, FID, Chemiluminescent analyzers, Gas chromatography, smoke meters.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Ayhan Demirbas, "Biodiesel A Realistic Fuel Alternative for Diesel
2. Dr. S. Thipse, Alternate Fuels, Jaico Publications.
3. John Heywood "Internal Combustion Engine Fundamentals" 2017
4. Bechtold R., Alternative Fuels Guidebook.
5. Crouse and Anglin, Automotive Emission Control, McGraw Hill

REFERENCES:

1. Pundir B.P, I.C. Engines Combustion and Emission, 2010, Narosa Publishing House.
2. Richard L. Bechtold, Automotive Fuels Guide Book, SAE Publications, 1997
3. Bechtold, Richard. L., "Alternate Fuels – Transportation Fuels for Today and Tomorrow", Society of Automotive Engineers (SAE) – 2002.
4. Hydrogen and Fuel Cells: Emerging Technologies and Applications, Bent Sorensen, Elsevier Academic Press, UK
5. Watson, E.B., "Alternative fuels for the combustion engine", ASME, 2011.

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6. Mahaeswari R.C., "Bio Energy for Rural Energisation", Concepts Publication,1997.
7. David M Mousdale, "Introduction to Biofuels", CRC Press, 2010.

WEB REFERENCES:

1. https://afdc.energy.gov/fuels/
2. https://www.energy.gov/eere/bioenergy/biofuels-basics
3. https://www.studentenergy.org/topics/biofuels
4. https://www.teriin.org/

ONLINE RESOURCES:

1. https://www.edx.org/course/from-fossil-resources-to-biomass-a-chemistry-persp
2. https://www.edx.org/course/catalytic-conversions-for-biobased-chemicals-and-p

OUTCOMES:

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

1. Employ the properties of alternative fuels for selecting appropriate fuels for IC engines.. (K3)
2. Analyze performance, combustion, and emission characteristics of biodiesel fuels in diesel engines. (K4)
3. Evaluate engine performance and emission characteristics using alcohol fuels. (K4)
4. Interpret the storage, safety issues, and combustion characteristics of gaseous fuels. (K4)
5. Examine the influence of synthetic fuels and additives on engine efficiency and exhaust emissions. (K4)
6. Apply emission control techniques such as EGR, SCR, and catalytic converters. (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	-	-	-	-	3	2
CO2	3	3	-	2	-	-	2	-	-	-	-	3	3
CO3	3	2	2	-	-	-	2	-	-	-	-	3	2
CO4	3	3	-	2	-	-	3	-	-	-	-	3	3
CO5	3	2	2	-	-	-	2	-	-	-	-	3	2
CO6	3	3	-	3	2	-	3	-	-	-	-	3	3

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEEL502	MEASUREMENTS IN THERMAL ENGINEERING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112106138	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 13				
PRE-REQUISITE COURSES	24MEPC402					

OBJECTIVES:

- To provide knowledge on the characteristics of various measuring instruments for thermal engineering.
- To provide the role of computers and microprocessors in the field of instrumentation systems.
- To provide knowledge on advanced measurement techniques and insights of various gas analyzing techniques.

MODULE - I MEASUREMENT CHARACTERISTICS **8**

Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

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MODULE - II SENSORS, TRANSDUCERS AND CALIBRATION 8

LVDT, strain gauge, capacitive, piezoelectric, optical and magnetic transducers; thermocouple, RTD, thermistor; calibration of sensors; electronic, fibre-optic and pneumatic transmitters; telemetry.

MODULE - III MEASUREMENT OF PHYSICAL QUANTITIES 8

Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow –use of sensors for physical variables.

MODULE - IV ADVANCED MEASUREMENT TECHNIQUES 8

Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, heat flux sensors, Telemetry in measurement.

MODULE - V MEASUREMENT ANALYSIS 7

Chemical thermal, magnetic and optical gas analyzers, measurement of smoke, Dust and moisture, gas chromatography, spectrometry, Measurement of pH.

MODULE - VI MICROPROCESSORS AND COMPUTERS IN MEASUREMENT 6

Data logging and acquisition – Sensors - types - use of sensors for error reduction, elements of micro- computer interfacing, and intelligent instruments in use.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Holman J.P., Experimental methods for engineers, McGraw-Hill, 2012
2. Doblin E.O, Measurement System Application and Design, Second Edition, McGraw Hill, 1978
3. Barnery, Intelligent Instrumentation, Prentice Hall of India, 1988.

REFERENCES:

1. John G Webster, The measurement, Instrumentation and sensors Handbook, CRC and IEE Press, 1999
2. Bolton. W, Industrial Control & Instrumentation, Universities Press, Second Edition, 2001

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3. Morris. A. S, Principles of Measurements and Instrumentation, Prentice Hall of India, 1998.
4. Patranabis. D, Transducers, Mechanical Measurement and Industrial Instrumentation, Tata McGraw - Hill Education (2010)

WEB REFERENCES:

1. https://nptel.ac.in/courses/112106138/
2. https://nptel.ac.in/courses/112106139/
3. https://nptel.ac.in/courses/112106140/

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=8DTt-f6wQxE
2. https://www.youtube.com/watch?v=lc4dsNvm2Ks
3. https://www.youtube.com/@nptelhrd
4. https://ocw.mit.edu

OUTCOMES:

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

1. Apply the concepts of instrument characteristics, error analysis, and uncertainty to select appropriate measuring instruments for engineering applications. (K3)
2. Implement the working principles of sensors and transducers and calibration techniques to analyze and measure engineering parameters accurately. (K3)
3. Utilize measurement techniques to evaluate thermo-physical properties and flow using suitable instruments and measurement systems. (K3)
4. Demonstrate the application of advanced measurement techniques in thermal engineering investigations. (K3)
5. Illustrate the use of gas analysis methods for analyzing thermal systems. (K3)

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

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEEL503	RENEWABLE ENERGY SOURCES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 121106014	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 11, 12, 13				
PRE-REQUISITE COURSES	24BSCY201					

OBJECTIVES:

- To understand and analyze the pattern of renewable energy resources.
- To impart knowledge and value of Solar Energy and Wind Energy.
- To suggest methodologies/technologies for utilization of waste in energy generation.
- To understand the economics of renewable energy sources, utilization, and environmental aspects.

MODULE - I FOUNDATIONS OF RENEWABLE ENERGY & GLOBAL CONTEXT **8**

Overview of World energy usage patterns and global energy reserves - Principles of renewable energy: Definitions, Classification, and importance - Conventional Vs non-conventional fuels: comparative analysis - Scientific principles, technical implications, and social dimensions of renewable energy - Environmental aspects of energy utilization: Emissions, Carbon footprint, Sustainability.

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MODULE - II RENEWABLE ENERGY ECONOMICS, POLICY & SUSTAINABILITY FRAMEWORK 7

Economics of renewable energy systems: LCOE, ROI, subsidies, and financing models -Renewable energy scenario: Tamil Nadu, India, and global perspectives - Potentials, achievements, and real-world applications across sectors - Policy frameworks, incentives, and regulatory mechanisms - Sustainability assessment and life-cycle analysis of renewable technologies - Integration of SDG indicators in energy planning and project evaluation.

MODULE - III SOLAR ENERGY TECHNOLOGIES & APPLICATIONS 8

Solar radiation: extra-terrestrial radiation, measurement, and estimation techniques - Solar thermal systems: flat plate & concentrating collectors, direct thermal applications - Solar thermal power generation: principles and plant configurations - Fundamentals of photovoltaic (PV) conversion: semiconductor physics, solar cell operation - Solar PV power generation: modules, arrays, inverters, balance of system - Applications: rooftop systems, solar pumps, lighting, and rural electrification - Grid integration, system design, and RAPS (Remote Area Power Supply) - Recent advancements: perovskite cells, bifacial modules, AI-based tracking

MODULE - IV WIND ENERGY SYSTEMS & GRID INTEGRATION 7

Basics of wind energy: wind resource assessment, power in the wind, Betz limit - Wind turbine technologies: HAWT Vs VAWT, components, materials, and control systems - Aerodynamics: forces, loads, and efficiency calculations for wind turbines - Electricity generation: generators, power electronics, and grid synchronization-Wind farm planning: siting, layout, environmental impact, and community engagement - Current and potential uses: onshore, offshore, hybrid systems-Challenges: intermittency, grid stability, noise, wildlife impact, and mitigation strategies

MODULE - V BIOMASS & BIOENERGY CONVERSION PATHWAYS 7

Biomass resources: agricultural residues, energy crops, municipal solid waste, algae - Thermo-chemical conversion: combustion, pyrolysis, gasification – principles and applications - Biochemical conversion: anaerobic digestion (biogas), fermentation (ethanol, biodiesel) - Technology comparison: efficiency, scalability, feedstock requirements, by-products - Recent advancements: advanced biofuels, co-firing, integrated bio-refineries.

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MODULE - VI EMERGING RENEWABLES, HYBRID SYSTEMS & FUTURE TRENDS 8

Geothermal energy: resource types, power plant cycles (dry steam, flash, binary) - Ocean energy: OTEC principles, tidal barrages, wave energy converters - Small hydro and micro-hydro systems: design considerations and environmental safeguards - Hydrogen economy: production (electrolysis, reforming), storage, and fuel cell systems - Hybrid renewable systems: solar-wind, solar-biomass, PV-fuel cell configurations - Energy storage integration: batteries, pumped hydro, thermal storage for grid stability - Current trends: digitalization, AI/ML in forecasting, community energy models.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Rai, G.D. Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 2017.
2. Twidell, J.W. & Weir, A. Renewable Energy Resources, EFN Spon Ltd., UK, 2015.

REFERENCES:

1. Khan, B.H. Non-Conventional Energy Resources, McGraw Hill, 2017.
2. Tiwari, G.N. Solar Energy – Fundamentals, Design, Modelling and Applications, Alpha Science Intl Ltd, 2013.
3. Boyle, Godfrey. Renewable Energy: Power for a Sustainable Future, Oxford University Press, UK, 2012.
4. Dewulf, J. & Van Langenhove, H. Renewables Based Technology: Sustainability Assessment, John Wiley & Sons, 2006.
5. Schlager, N. & Weisblatt, J. Alternative Energy, Thomson Gale, 2006.

WEB REFERENCES:

1. https://www.irena.org/
2. https://nise.res.in/hi
3. https://niwe.res.in/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/108/108108078/
2. https://nptel.ac.in/courses/112/105/112105050/
3. https://nptel.ac.in/courses/108/105/108105058/

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4. https://nptel.ac.in/courses/112/105/112105051/
5. https://nptel.ac.in/courses/103/107/103107125/

OUTCOMES:

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

1. Utilize renewable energy concepts to assess global energy consumption patterns, resource availability, and environmental implications. (K3)
2. Examine economic viability, policy mechanisms, and sustainability strategies for the implementation of renewable energy systems. (K4)
3. Investigate the operational characteristics and efficiency of solar thermal and photovoltaic technologies under different operating conditions. (K4)
4. Apply wind energy principles to estimate power generation and evaluate turbine performance and site suitability. (K3)
5. Analyze biomass conversion pathways in terms of efficiency, scalability, and environmental impact. (K3)
6. Evaluate hybrid renewable energy systems, energy storage solutions, and emerging technologies for enhancing future energy security and grid reliability. (K4)

CO - PO, PSO MAPPING:

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

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REFERENCES:

1. Gary L. Workman, Patrick O. Moore, Doron Kishoni, "Non-destructive, Hand Book, Ultrasonic Testing", 3rd edition, Amer Society for Nondestructive, 2007.
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: 24MEEL507	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112105046	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9, 11, 12				
PRE-REQUISITE COURSES	24CEPC305					

OBJECTIVES:

- To understand the fundamental principles of fluid power systems.
- To study the functions of components used in modern hydraulic and pneumatic systems.
- To develop competence in the design, construction, and operation of fluid power circuits.
- To develop automated systems by integrating electro-pneumatic controls, ladder diagrams, and PLC-based logic for low-cost automation in industry.
- To identify various troubleshooting methods in fluid power systems.

MODULE - I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 8

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque- Problems.

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Sources of Hydraulic power: Pumping Theory– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps.

MODULE - II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 7

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors.

Control Components and Accessories: Direction Control, Flow control and pressure control valves – Types, Construction and Operation- Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols.

MODULE - III HYDRAULIC CIRCUITS AND SYSTEMS 8

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.

MODULE - IV PNEUMATIC CIRCUITS AND SYSTEMS 7

Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method.

MODULE - V ELECTRO PNEUMATIC SYSTEMS AND TROUBLE SHOOTING 8

Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits- Integration of fringe circuits.

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids.

MODULE - VI APPLICATIONS OF HYDRAULIC AND PNEUMATIC CIRCUITS 7

Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. –

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Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997

REFERENCES:

1. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
2. Joshi.P., Pneumatic Control", Wiley India, 2008.
3. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance",TataMcGraw Hill, 2001.
4. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
5. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3rd edition,2019.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/105/112105046/
2. http://nitc.ac.in/index.php/?url=users/view/270/12/3
3. https://www.e4training.com/index.php
4. https://www.hydraulicspneumatics.com/learning-resources

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/105/112105047/
2. https://nptel.ac.in/courses/112/103/112103249/
3. https://nptel.ac.in/courses/112/106/112106175/
4. https://www.coursera.org/learn/fluid-power

OUTCOMES:

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

1. Explain the principles of fluid power systems, properties of fluids, Pascal's law, and the working of hydraulic pumps with their performance characteristics. (K2)

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2. Describe the construction, operation, and applications of hydraulic actuators and control components such as valves, reservoirs, filters, and accessories. (K2)
3. Apply the concepts of hydraulic circuits and components to analyze and solve problems in industrial hydraulic systems. (K3)
4. Apply pneumatic principles to design and develop single and multi-cylinder pneumatic circuits using standard symbols and methods. (K3)
5. Apply electro-pneumatic concepts to construct ladder diagrams, implement control circuits, and perform basic troubleshooting of fluid power systems. (K3)
6. Apply hydraulic and pneumatic principles to design circuits for industrial applications such as machine tools, material handling, and automation systems. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2	3
CO2	3	2	-	-	2	-	-	-	-	-	-	2	2	3
CO3	3	3	2	2	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	2	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	2	3	-	-	-	-	-	2	3	3	3
CO6	3	3	3	2	3	-	-	-	-	-	2	3	3	

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PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEEL508	INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112105319	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11, 12, 13				
PRE-REQUISITE COURSES	24MEPC403					

OBJECTIVES:

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems, Sensors, their applications in robots and programming of robots.
- To select the robots according to its usage.
- To discuss about the various applications of robots, justification and implementation of robot.
- To know about material handling in a system.

MODULE - I INTRODUCTION 9

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

MODULE - II ROBOTS FOR INSPECTION AND OTHER APPLICATIONS 9

Robotic vision systems, image representation, object recognition and Categorization, image data compression, software considerations. Application of Robots in continuous arc welding process, cleaning, robot for underwater applications.

MODULE - III END EFFECTORS 9

Gripper force analysis and gripper design for typical applications, design of multiple degrees of freedom, active and passive grippers.

MODULE - IV SELECTION OF ROBOT 9

Factors influencing the selection of a robot, robot performance analysis, Economics of robotisation, Impact of robot on industry and society.

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MODULE - V MATERIAL HANDLING 5

Concept 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, advanced material handling systems, automated guided vehicles, automated storage and retrieval systems (ASRS), bar code technology, radio frequency identification technology analysis – NPV, Benefits and costs over time, ROI, IRR; Work and Cost breakdown structure.

MODULE - VI AGVs & AMRs 4

Automated guided vehicles, Automated storage and retrieval systems(ASRS), bar code technology, Autonomous mobile Robots, Map technology, Navigation, radio frequency identification technology analysis – NPV, Benefits and costs over time, ROI, IRR; Work and Cost breakdown structure.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Richard D Klafter, Thomas Achmielewski and MickaelNegin, —Robotic Engineering – An integrated Approach, Prentice Hall India, New Delhi, 2001.
2. Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, 2015.

REFERENCES:

1. James A Rehg, —Introduction to Robotics in CIM Systems, Prentice Hall of India, 2002.
2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 1994.

WEB REFERENCES:

1. https://www.machinedesign.com/mechanical-motion-systems/article/21831692/the-difference-between-cartesian-six-axis-and-scara-robots
2. https://www.automate.org/robotics/safety/robot-safety-standard-documents
3. https://www.iso.org/standard/51330.html

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ONLINE RESOURCES:

1. https://blog.robotiq.com/bid/63528/what-are-the-different-types-ofindustrial-robots
2. https://www.youtube.com/watch?v=EeIwoNqxtpg&feature=youtu.be
3. https://blog.robotiq.com/bid/63528/what-are-the-different-types-of-industrial-robots

OUTCOMES:

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

1. Discuss the fundamentals of industrial robots, configurations, and robotic work cells. (K3)
2. Analyze robotic vision systems and applications of robots in industrial processes. (K4)
3. Design and analyze end effectors and grippers for specific industrial applications. (K5)
4. Evaluate robot selection criteria, performance, and economic feasibility of robotization. (K4)
5. Analyze conventional and automated material handling systems for industrial applications. (K4)
6. Apply robotic and material handling systems to improve productivity and automation in manufacturing industries. (K3)

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

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PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEEL509	REVERSE ENGINEERING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24MEPW301					

OBJECTIVES:

- Applying the fundamental concepts and principles of reverse engineering in product design and development.
- Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Applying the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
- Analyzing the various legal aspect and applications of reverse engineering in product design and development.

MODULE - I INTRODUCTION TO REVERSE ENGINEERING 7

Definition and Objectives of Reverse Engineering – Applications and Benefits – Generic Reverse Engineering Process – Phases of Reverse Engineering – Computer Aided Reverse Engineering (CARE) – Role of CAD/CAM/CAE in Reverse Engineering.

MODULE - II GEOMETRIC MODELING AND PROTOTYPING 7

Surface Reconstruction Techniques – Solid Model Reconstruction – Geometric Data Acquisition – Dimensional Measurement Techniques – Coordinate Measuring Machines (CMM) – Rapid Prototyping and Additive Manufacturing in Reverse Engineering.

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MODULE - III MATERIAL CHARACTERISTICS AND FAILURE ANALYSIS 8

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength and Hardness Evaluation – Part Failure Analysis – Fatigue, Creep and Stress Rupture – Environmentally Induced Failures.

MODULE - IV MATERIAL IDENTIFICATION AND PROCESS VERIFICATION 7

Material Specifications and Standards – Composition Determination Techniques – Microstructure Analysis – Manufacturing Process Identification – Process Verification and Validation – Quality Assessment Methods.

MODULE - V DATA PROCESSING AND PERFORMANCE EVALUATION 8

Statistical and Data Analysis Techniques – Reliability Concepts and Theory of Interference – Weibull Analysis – Data Conformity and Acceptance Criteria – Preparation of Data Reports – Methodology for Performance Evaluation.

MODULE - VI LEGALITY AND INDUSTRIAL APPLICATIONS OF REVERSE ENGINEERING 8

Legal and Ethical Aspects of Reverse Engineering – Patent, Copyright and Trade Secret Issues – Third-Party Materials and Intellectual Property Rights – Applications of Reverse Engineering in Automotive, Aerospace and Medical Device Industries.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Katheryn A. Ingle, Reverse Engineering, McGraw-Hill, 1994.
2. Reverse Engineering: An Industrial Perspective, Raja and Fernandes, Springer, 2008.

REFERENCES:

1. Donald R. Honsa, Co-ordinate Measurement and Reverse Engineering, American Gear Manufacturers Association, ISBN 1555897.
2. Peter Aiken, Data Reverse Engineering, McGraw-Hill, 1996.
3. T. J. Biggerstaff, Design Recovery for Maintenance and Reuse, IEEE Corporation, July 1991.

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4. Linda Wills, Reverse Engineering, Kluwer Academic Publishers, 1996.
5. S. Rugaban, White Paper on Reverse Engineering, Technical Report, Georgia Institute of Technology, 1994.

WEB REFERENCES:

1. https://hackersonlineclub.com/reverse-engineering/
2. https://www.godaddy.com/resources/in/web-pro-in/the-proper-use-of-reverse-engineering
3. https://en.wikipedia.org/wiki/Reverse_engineering
4. https://uniathena.com/reverse-engineering-techniques-tools-project-management-experts
5. https://www.infosecinstitute.com/resources/reverse-engineering/top-8-reverse-engineering-tools-cyber-security-professionals/

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=5FXrCHLAJZM
2. https://www.youtube.com/watch?v=W2QpGdsTIJ8
3. https://nptel.ac.in/courses/112104265
4. https://www.youtube.com/watch?v=cqML1ZOVVSI
5. https://www.youtube.com/watch?v=HbVimUG1hq8

OUTCOMES:

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

1. Describe the fundamental concepts and principles of reverse engineering in product design and development. (K3)
2. Develop and validate reverse-engineered product models using geometric data acquisition, reconstruction techniques, coordinate measuring machines and additive manufacturing technologies. (K3)
3. Analyse material characteristics, mechanical properties and failure mechanisms to evaluate component durability and service life. (K3)
4. Examine material composition and manufacturing processes to verify product specifications and quality requirements. (K3)
5. Utilize statistical data analysis, reliability assessment and performance evaluation techniques to validate reverse-engineered products. (K3)
6. Evaluate legal and ethical considerations associated with reverse engineering and its industrial applications. (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	2
CO2	2	2	3	2	3	-	-	-	-	-	-	3	2
CO3	2	3	2	3	2	-	-	-	-	-	-	2	2
CO4	2	3	2	2	2	-	-	-	-	-	-	3	2
CO5	2	3	2	3	2	-	-	-	-	-	-	2	2
CO6	2	2	2	2	2	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVE - I

COURSE CODE: 20MEEL510	AUTOMATION IN PRODUCTION SYSTEMS AND MANAGEMENT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 110105155	SYLLABUS VERSION 1.0	SDG NO. 8, 9, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To introduce the fundamentals of automation in manufacturing and production systems.
- To understand numerical control, programmable automation, flexible manufacturing systems, and robotics.
- To develop knowledge of computer-aided process planning and Industry 4.0 concepts.
- To enable students to analyze and design automated production systems for improved productivity and quality

MODULE - I INTRODUCTION TO MANUFACTURING AND PRODUCTION SYSTEMS **8**

Basic concepts of manufacturing systems, evolution of manufacturing systems, types of manufacturing systems, role of automation, product–process–flexibility matrices, production system design criteria, manufacturing system components.

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MODULE - II AUTOMATION IN MANUFACTURING SYSTEMS 10

Automation principles and strategies, automated production system framework, Industry 4.0 concepts, automation technologies, fixed, programmable and flexible automation

MODULE - III PRODUCT DEVELOPMENT AND NC TECHNOLOGY 8

Product development process, concurrent engineering, design-manufacturing interaction, fundamentals of numerical control (NC), CNC systems, NC programming concepts.

MODULE - IV FLEXIBLE AND PROGRAMMABLE AUTOMATION 8

Programmable automation, cellular manufacturing systems, group technology, flexible manufacturing systems (FMS), FMS components, planning and control

MODULE - V ROBOTICS AND AUTOMATED PROCESS PLANNING 6

Fundamentals of robotic systems, robot configurations, robot applications in manufacturing, automated computer-aided process planning (CAPP), variant and generative approaches

MODULE - VI ADVANCED AUTOMATION AND MANAGEMENT 5

Integrated manufacturing systems, computer integrated manufacturing (CIM), automation management issues, productivity improvement, quality enhancement, future trends in smart manufacturing

TOTAL : 45 PERIODS

TEXT BOOK:

1. Mikell P. Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", 4th Edition, Pearson.
2. Mikell P. Groover, "Fundamentals of Modern Manufacturing", Wiley

REFERENCES:

1. Yoram Koren, "Computer Control of Manufacturing Systems", McGraw Hill.
2. Gideon Halevi and Roland Weill, "Principles of Process Planning", Chapman & Hall.
3. P. Radhakrishnan, S. Subramanyan and V. Raju, "CAD/CAM/CIM", New Age International

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WEB REFERENCES:

1. https://nptel.ac.in/courses/110105155
2. https://onlinecourses.nptel.ac.in

ONLINE RESOURCES:

1. NPTEL Video Lectures by Prof. Pradip Kumar Ray, IIT Kharagpur.

OUTCOMES:

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

1. Apply the concepts and components of manufacturing and production systems.(K3)
2. Develop automation principles and strategies in manufacturing environments.(K3)
3. Apply NC/CNC technologies and product development processes.(K3)
4. Model flexible manufacturing systems and programmable automation techniques.(K3)
5. Apply robotics and computer-aided process planning concepts in production systems.(K3)
6. Experiment with advanced automation, CIM, and Industry 4.0 applications for productivity improvement. (K3)

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

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PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEEL511	LEAN AND AGILE MANUFACTURING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 1031077125	SYLLABUS VERSION 1.0	SDG NO. 8, 9, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To introduce the principles of Lean Manufacturing.
- To introduce the tools for cost reduction and profitability.
- To explore the various Visual management techniques and lean practices.
- To know the concepts of Agile Manufacturing and its drivers

MODULE - I LEAN MANUFACTURING PRINCIPLES AND CONCEPTS 7

Definition and objectives of lean manufacturing - Origin -Key principles and implications of lean manufacturing-Toyota Production System-Value creation and waste elimination-tools and techniques applied to eliminate waste-Main kinds of waste- Traditional vs Lean Manufacturing.

MODULE - II LEAN MANUFACTURING TOOLS AND METHODOLOGIES 8

5s concepts-Stages of 5s and elimination of waste-Kaizen-Steps of kaizen-Poka Yoke - Desing for Manufacturing and Assembly (DFMA) - Principles - Single Minute Exchange of Die (SMED) - Principles - Design of SMED - Total Productive Maintenance (TPM)-Principles-Pull Production through Kanban-Kanban Circles-Tact time,Cycle time,Target Cycle time

MODULE - III VISUAL MANAGEMENT AND LEAN IMPLEMENTATION 7

Visual Management-Tools for eliminating wastes-Overproduction- Inventory - Delay - Transportation - Processing - Unnecessary motion - Defective parts - Implementation of Lean practices.

MODULE - IV AGILE MANUFACTURING 8

Defintion - Conceptual framework - Characteristics - Generic features - Aggregate Capacity Planning and Production line design / redesign in Agile Manufacturing - Robust Design Approach - Approaches to enhance agility in manufacturing-Role of QFD-Managing people in Agile Organization

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MODULE - V MANAGEMENT TECHNOLOGY 7

Management driver - Organizational structure - Employee Status and Involvement - Time Management - Application of multimedia to improve agility in Manufacturing

MODULE - VI COMPETITIVE DRIVERS OF AGILE MANUFACTURING 8

Agility through technology driver - Competitive driver-Status of Quality and Productivity-Outsourcing-Implementation of Agile Manufacturing

TOTAL : 45 PERIODS

TEXT BOOK:

1. Devadasan SR,Mohan Siva kumar V,Murugesh R and Shalij PR,"Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities", Prentice Hall of India (PHI)Private Limited, New Delhi, India,2012.
2. M.P.Chowdiah, "Agile Manufacturing: Globalised Customerized Green Products", I.K International Publishing House Pvt Ltd, Recent Edition, 2013.

REFERENCES:

1. Bill Carreira, " Lean Manufacturing That Works ",PHI Learning Private Limited, Recent Special Edition 2018.
2. Dennis P. Hobbs, " Lean Manufacturing Implementation ", 1st edition, J.Ross Publishing 2003.
3. Gopalakrishnan.N,"Simplified Lean Manufacture:Elements,Rules,Tools and Implementation", PHILearningPrivateLimited,2010.

WEB REFERENCES:

1. https://www.lean.org/lexicon-terms/lean-production/
2. https://global.toyota/en/company/vision-and-philosophy/production-system/
3. https://www.agilebusiness.org/resources/case-studies.html

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110105039
2. https://www.coursera.org/courses?query=six%20sigma

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OUTCOMES:

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

1. Analyze the principles, concepts, and philosophy of Lean Manufacturing and identify value-added and non-value-added activities in manufacturing systems.(K4)
2. Classify Lean Manufacturing tools such as 5S, Kaizen, Poka-Yoke, SMED, TPM, and Kanban for process improvement and waste reduction.(K4)
3. Dissect visual management techniques and lean practices to improve productivity and operational efficiency in manufacturing environments.(K4)
4. Evaluate Agile Manufacturing concepts for capacity planning, production system design, and organizational responsiveness.(K4)
5. Analyze management technologies, organizational factors, and competitive drivers influencing agile manufacturing systems.(K4)
6. Examine manufacturing systems by integrating Lean and Agile principles to achieve flexibility, quality, productivity, and customer satisfaction.(K4)

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

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PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEEL512	DIGITAL MANUFACTURING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To know the concepts of Digital Manufacturing
- To Practice the methods of solving problems using Artificial Intelligence
- To build components of intelligent decision support system for Manufacturing
- To impart knowledge of sensor technologies used in the manufacturing industry for monitoring workpiece, machine tools, machining processes and advanced sensors.

MODULE - I INTRODUCTION 9

Definition of digital manufacturing, Historical perspective on industrial production and outlook, Industrial Revolutions, Industry 4.0, Cyber physical system, Factory of the future, Operation Mode and Architecture of Digital Manufacturing System.

MODULE - II DIGITAL MANUFACTURING 9

Digital Manufacturing and Design Operation Mode and Architecture of Digital Manufacturing System, Digital Thread-Components and Implementation, Advanced Manufacturing Process Analysis, Intelligent Machining, Advanced Manufacturing Enterprise, Cyber Security in Manufacturing, Model Based Systems Engineering.

MODULE - III DESIGN PROCESS AND DIGITAL TWIN 9

Design process and role of CAD, Types and applications of design models, Three dimensional modeling schemes, Wire frames and surface representation schemes, Solid modeling - Parametric modeling, Assembly modeling. Digital twin - Definition, types of Industry & its key requirements,

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Importance, Application of Digital Twin in process, product, service industries, History of Digital Twin, DTT role in industry innovation, Technologies/tools enabling Digital Twin, Industrial Revolutions

MODULE - IV REVERSE ENGINEERING AND CAD **9**

Reverse Engineering: Need, Reverse engineering process, Reverse engineering hardware and software, Geometric model development. Computer Aided Manufacturing: Component modeling, Machine and tool selection, Defining process and parameters, Tool path generation, Simulation, Post processing.

MODULE - V ADDITIVE MANUFACTURING FOR DIGITAL TRANSFORMATION **5**

Introduction to additive manufacturing, Additive manufacturing process chain, Material selection, Manufacturing, Post processing, Additive manufacturing technologies and processes, Vat photo polymerization, Material extrusion, Material jetting, Sheet lamination, Powder bed fusion, Binder jetting, Planning and slicing additive manufacturing software.

MODULE - VI CONCEPT MODELERS, TRANSLATORS AND 3D PRINTING SOFTWARE **4**

Introduction, Principle, Thermo jet printer, Sander's model market, 3- D printer, Genisys Xs printer, JP system 5, object quadra System-Rapid proto typing. Standard interface to convey geometric description from CAD package to Rapid prototyping system, Stereo Lithography (STL)file, Initial Graphics Exchange Specification(IGES)file, Hewlett-Packard Graphics Language (HP/GL) file. Additive manufacturing software for editing features and to export files to printers: Ansys, Autodesk Netfabb, 3dSystems, Materialise Magics, Solid Edge, Amphyon.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Zude Zhou Shane (Shengquan) Xie Dejun Chen,"Fundamentals of Digital Manufacturing Science''Springer Series in Advanced Manufacturing,2012 (Unit-I)
2. Ibrahim Zeid and Siva subramanian R, "CAD/CAM - Theory and Practice", Tata McGraw Hill Education, 2011. (Unit-II)

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3. Vinesh Raja and Kiran J Fernandes, "Reverse Engineering- An Industrial Perspective", Springer-Verlag, 2008 (Unit-III)
4. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 3rd Edition, World scientific publications, 2014.(Unit-IV&V).

REFERENCES:

1. Pham D T and Dimov S, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping", Springer-Verlag, 2001.
2. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", Springer, 2005.
3. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer, 2004.

WEB REFERENCES:

1. https://www.internetsociety.org/iot/
2. https://event.asme.org/digitaltwin/About/Digital-Twin-Resources

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/courses/106/105/106105195/
3. https://www.edx.org/course/industry-40-how-to-revolutionize-yourbusiness
4. https://www.coursera.org/specializations/digital-manufacturing design-technology

OUTCOMES:

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

1. Apply the concepts, architecture, and operational principles of Digital Manufacturing Systems, Industry 4.0, Cyber-Physical Systems, and smart factories. (K3)
2. Apply digital manufacturing frameworks including Digital Thread, intelligent manufacturing systems, cyber security, and model-based systems engineering. (K3)
3. Apply CAD-based design methodologies, three-dimensional modeling techniques, and Digital Twin concepts in manufacturing applications. (K3)

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4. Develop and process engineering models using reverse engineering techniques, CAD/CAM integration, and manufacturing process simulation tools. (K3)
5. Build additive manufacturing technologies, process chains, material selection, process planning, and post-processing requirements for digital transformation. (K3)
6. Discover the effectiveness of concept modelers, 3D printing technologies, file formats, and additive manufacturing software tools for modern manufacturing applications. (K3)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24MEIE501	ADDITIVE MANUFACTURING PROCESSES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 1031077125	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 11, 12, 13				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To impart the knowledge on additive manufacturing fundamentals and various 3D printing technologies.
- To familiarize the concept of preprocessing and post processing methods for the additive manufacturing.
- To explore the various 3D printing tools for components

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MODULE - I INTRODUCTION TO ADDITIVE MANUFACTURING 6

Additive Manufacturing Terminologies – Concepts of Layer Manufacturing – Additive Manufacturing Vs Subtractive Manufacturing – Custom, Batch and Mass Production Scenarios – Role of AM in Product Development – Applications of AM in Automotive, Aerospace and Bio-medical

MODULE - II PLANNING FOR ADDITIVE MANUFACTURING 7

3D Model Data Creation, Concept of Reverse Engineering, Data collection, Modeling for printing – File Formats: STL, OBJ, AMF, 3MF, CLI – STL file Errors, Correction and Printability Analysis – Optimization of Part Orientation and Support Structure Generation - Types of Supports – Slicing Parameters – Tool Path Generation.

MODULE - III ADDITIVE MANUFACTURING TECHNOLOGIES 8

Extrusion Based Technologies – FDM, Stereolithography and other Photo polymerization based Technologies – SLA & DLP, Laser Sintering – SLS & DMLS, Laser and Electron Beam Powder Bed Fusion Technologies – SLM&EBM, Wire and Powder based Direct Energy Deposition Technologies – Material Jetting – Binder Jetting – Hybrid AM Processes.

MODULE - IV POST-PROCESSING FOR ADDITIVE MANUFACTURING 8

Support Structure Removal – Surface Texture Improvement – Surface Treatments – Polymer & Metal , Heat Treatment – HIP & Residual Stress Relieving, UV Curing – Cleaning & de-powdering – Machining – Surface Coating & Infiltration.

MODULE - V DESIGN FOR ADDITIVE MANUFACTURING 8

General Guidelines – Exploring Unique Capabilities and Design Freedom – Complex Geometries – Customized Geometries – Part Consolidation – Tooling Design – Design Guidelines for Printing Polymer parts, Metal parts, Ceramic and Sand mould – Functionality based DFAM – Case Studies.

MODULE - VI MATERIALS FOR AM 8

Selection of candidate materials for Additive Manufacturing, Nature of Polymers for AM environment , Am thermoplastics and thermosetting polymers, Types of Polymerizations at 3D printing environment, Properties of Polymers based on FDM, SLA/DLP, and SLS, Degradation of Polymers after printing, Metal and Ceramic Powders for AM, Composites, Functionally Graded Materials (FGM's) for 3D printing.

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TEXT BOOK:

1. Andreas Gebhardt, Jan-Steffen Hötter, Additive Manufacturing: 3D Printing for Prototyping and Manufacturing, 2016, Hanser Publishers, Munich.
2. 2. Olaf Diegel, Axel Nordin, Damien Motte, A Practical Guide to Design for Additive Manufacturing, 2020, Springer Nature Singapore Pte Ltd.
3. 3. C P Paul , A N Jinoop, Additive Manufacturing – Pricniples, technologies and Applications, 2021, Mc Graw Hill Publication.

REFERENCES:

1. Ben Redwood, Filemon Schöffer, Brian Garret, The 3D Printing Handbook, 2017, 3D Hubs.
2. Srivatsan, T. S., Sudarshan, T. S, Additive manufacturing: innovations, advances, and applications, 2016, CRC Press.

WEB REFERENCES:

1. National Programme on Technology Enhanced Learning – https://nptel.ac.in
2. ASTM International – https://www.astm.org (AM standards – ASTM F42)
3. ISO – https://www.iso.org (ISO/TC 261 – Additive Manufacturing)
4. SME (Society of Manufacturing Engineers) – https://www.sme.org
5. Additive Manufacturing Media – https://www.additivemanufacturing .media

ONLINE RESOURCES:

1. Coursera: 3D Printing Applications
2. edX: Additive Manufacturing for Innovative Design and Production
3. NPTEL Course: Additive Manufacturing
4. Autodesk Fusion 360, Practical Machinist (AM tutorials)

OUTCOMES:

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

1. Apply additive manufacturing fundamentals and compare AM with conventional manufacturing processes. (K3)
2. Analyze AM process planning including slicing, support generation, and tool path strategies. (K4)
3. Apply various additive manufacturing technologies (FDM, SLM, DMLS, etc.) for suitable applications. (K3)

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4. Analyze post-processing techniques and their effects on surface finish and mechanical properties. (K4)
5. Apply design for additive manufacturing (DFAM) principles for optimized product development. (K3)
6. Analyze material selection and behavior (polymers, metals, composites) in additive manufacturing processes. (K4)

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL513	BASIC ENVIRONMENTAL ENGINEERING AND POLLUTION ABATEMENT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 103107215	SYLLABUS VERSION 1.0	SDG NO. 6, 11, 12, 13, 15				
PRE-REQUISITE COURSES	24MEPC401					

OBJECTIVES:

- To understand the fundamental knowledge of environmental engineering long with the design aspect of some pollution control equipment.
- To learn about quality standards and characterization.
- To gain awareness of treatment process and equipment and industrial pollution control.

MODULE - I INTRODUCTION TO ECOSYSTEM AND POLLUTION 5

Introduction - Ecology, environment and biodiversity - Ecosystem services and its risk. Pollution types and sources - Impact/consequences of pollutants - Transmission of pollutants in environment.

MODULE - II QUALITY STANDARDS AND CHARACTERIZATION 8

Ambient air quality and standards - Water quality and standards - Industrial pollution and standards. Sampling and Characterization of gas/air/emission-water/waste water -Solid wastes and soil - Environmental law and regulatory framework

MODULE - III POLLUTION PREVENTION STRATEGIES AND CONTROL 5

Pollution prevention strategies and processes - Pollution prevention by using optimum water - Air pollution control methods

MODULE - IV TREATMENT PROCESS AND EQUIPMENT 9

Treatment of surface and ground water for drinking water generation - Treatment of domestic and industrial waste water – Schemes - Primary treatment equipment - Secondary treatment process. Secondary treatment equipment - Advances in secondary treatment process. Tertiary treatment - Sludge management - Pollution control in industry

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MODULE - V INDUSTRIAL POLLUTION CONTROL 9

Industrial pollution control in GPI 1 - Industrial pollution control in GPI 2 - Industrial pollution control in GPI 3 - Industrial pollution control in GPI 4.Industrial pollution control in GPI 5.

MODULE - VI SOLID WASTE MANAGEMENT 9

Solid waste management schemes - Solid waste transformation 1(incineration) - Solid waste transformation 2 (gasification) - Solid waste transformation 3 (Pyrolysis) - Solid waste transformation 4 (Anaerobic digestion) - Hazardous waste management - Management of special category wastes.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Vallero D., "Fundamentals of Air Pollution", 4th Ed. Academic Press.(2007)
2. Eckenfelder W. W., "Industrial water pollution Control", 2nd Ed., McGraw Hill.(1999)
3. Kreith F. and Tchobanoglous G., "handbook of Solid waste Management", 2nd Ed., McGraw Hill.(2002)
4. Tchobanoglous G., Burton F. L. and Stensel H.D., "Waste Water Engineering: Treatment and Reuse", 4th Ed., Tata McGraw Hill.(2003)

REFERENCES:

1. PichtelJ.,"Waste Management Practices: Municipal, Hazardous and Industrial",CRC.(2005)
2. "Pollution Control Acts, Rules, Notification issued there under" CPCB, Ministry of Env. And Forest, G.O.I., 3rd Ed.(2006)

WEB REFERENCES:

1. https://www.epa.gov/environmental-topics/water-topics
2. https://www.epa.gov/npdes/industrial-wastewater
3. https://www.epa.gov/npdes/municipal-wastewater

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/103107084
2. https://nptel.ac.in/courses/105102089
3. https://nptel.ac.in/courses/105104099

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OUTCOMES:

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

1. Discuss the ecosystem concepts, types of pollution, sources, and their environmental impacts. (K3)
2. Describe environmental quality standards and methods for sampling and characterization of air, water, and soil. (K3)
3. Apply pollution prevention strategies and select appropriate air pollution control methods. (K3)
4. Apply principles of water and wastewater treatment processes and identify suitable treatment equipment. (K3)
5. Apply concepts of industrial pollution control in various process industries. (K3)
6. Apply solid waste management techniques including treatment and disposal methods. (K3)

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL514	INTERNAL COMBUSTION ENGINES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 7, 9, 12, 15				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To recall the air standard cycles and comparison with actual cycles, classification and working principles of air standard and actual cycles.
- Understand the process of combustion IC engines and deal with the practical challenges in combustion process.
- Evaluate the performance parameters of IC engines by conducting the performance tests

MODULE - I INTRODUCTION TO IC ENGINE 7

Internal Combustion Engine: S.I. and C.I. engines of two and four stroke cycles, real cycle analysis of SI and CI engines, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, performance characteristics of SI and CI engines, cylinder arrangement, firing order, power balance for multi-cylinder engines.

MODULE - II COMBUSTION IN SI ENGINES 8

Flame development and propagation, Pressure-Crank Angle diagram, Stages of Combustion ignition lag, effect of air density, temperature, engine speed, turbulence and ignition timings, physical and chemical aspects, abnormal Combustion, effect of engine and fuel variables on abnormal combustion, pre-ignition, its causes and remedy, salient features of various type combustion chambers.

MODULE - III COMBUSTION IN CI ENGINES 8

Various stages of combustion in CI Engines, delay period, diesel knock, knock inhibitors, salient features of various types of combustion chambers. Cetane number, fuel properties,

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MODULE - IV FUEL INJECTION SYSTEMS FOR SI & CI ENGINES 7

Fuel injection in CI engine, Working Principle of fuel pump & fuel injectors, types of nozzles. Fuel injection in SI engine (MPFI, TBI, CRDI), Theory of carburetion, Solex Carburetor, simple Carburetor, problems on carburetion. Fuel metering in CI engines

MODULE - V FUELS 8

Classification of IC Engine fuels, Desirable characteristics of SI & CI engine fuels, Rating of SI & CI engine fuels, Alternative fuels for SI and CI engine (liquid, gaseous, hydrogen, LPG, CNG, Biogas etc.), Air requirements, Analysis of combustion products, HHV and LHV of fuels.

MODULE - VI SUPERCHARGING & TURBO CHARGING 7

Methods of supercharging, & turbo charging Effects of super charging and turbo charging. Engine Modifications for supercharging, supercharging of two stroke engines. Microprocessor controlled supercharging. Cooling & lubrication of SI & CI Engines.

TOTAL : 45 PERIODS

TEXT BOOK:

1. J.B. Heywood. Internal combustion Engines, Wiley
2. 2. Ganesan. V, Internal Combustion engines; TMH
3. 3. Mathur M L & Sharma RP; A. Course in IC engines; Dhanpat Rai

REFERENCES:

1. A course Internal combustion engines by V.M.A. Domkundwar, Dhanapat Rai publications.
2. A course internal combustion engines by M.L.Mathur and R.P.Sharma, Dhanapat Rai publications. 6. Internal combustion engines by K.k Ramalingam, Scitech Publications (India) Pvt.Ltd, 2000
3. A Text Book of Internal combustion engines by R.K. Rajput, Laxmi Pub, Pvt., 2006

WEB REFERENCES:

1. https://ocw.mit.edu/courses/2-61-internal-combustion-engines-spring-2017/resources/mit2_61s17_lec16/?utm_source=chatgpt.com
2. https://learnmechanical.com/internal-combustion-engine-history-definition-parts-pdf/

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3. https://ocw.iti.hr/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/lecture-notes

ONLINE RESOURCES:

1. https://www.scribd.com/document/679856069/AL
2. https://greavescotton.com/blogs/comprehensive-guide-to-internal-combustion-engies/?srsltid=AfmBOoqF11_GBevRqrP0s7vz1HUBGTVcmDcJ6-HSJmMWkQZLqNDi2EPn
3. https://www.energy.gov/eere/vehicles/road-rail-marine-and-aviation

OUTCOMES:

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

1. Demonstrate thermodynamic principles to analyze SI and CI engine cycles and evaluate engine performance parameters. (K3)
2. Apply combustion principles to analyze flame propagation, ignition, and abnormal combustion phenomena in SI engines. (K3)
3. Employ combustion concepts to evaluate combustion stages, knock characteristics, and fuel properties in CI engines. (K3)
4. Select appropriate fuel supply systems for SI and CI engines using fuel injection and carburetion principles. (K3)
5. Apply fuel properties and combustion analysis to evaluate engine fuels and alternative fuel performance. (K3)
6. Illustrate the use of supercharging and turbocharging techniques to improve engine performance and efficiency. (K3)

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

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL515	SOLAR ENERGY SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 115103123	SYLLABUS VERSION 1.0	SDG NO. 4, 7, 12, 15				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand solar radiation fundamentals, measurement principles, and geometric modeling to assess solar energy potential.
- To analyze and design solar thermal and photovoltaic systems for diverse energy conversion applications.
- To integrate solar solutions with storage, hybrid systems, and grid infrastructure for sustainable energy deployment.
- To evaluate emerging solar technologies, policy frameworks, and socio-technical strategies aligned with global SDGs.

MODULE - I ENERGY FOUNDATIONS & SOLAR RADIATION BASICS 7

Energy–Economy–Society Link - Energy Sources: Classification of energy sources: renewable vs. non-renewable, primary vs. secondary - Environmental Impact - Global & Indian Energy Scenario - Solar & EM Spectrum - Radiation Laws - Sun as Energy Source - Solar Constant - Energy Balance

MODULE - II SOLAR RADIATION MEASUREMENT & INSTRUMENTATION 8

Radiation Types - Solar Spectrum Standards - Atmospheric Effects - Air Mass (AM) - Measurement Principles – Instruments: Pyranometer: working principle, calibration, applications - Pyrheliometer: direct beam measurement • Sunshine recorders: Campbell-Stokes, electronic - sensors - Data Sources - Geographic Basics - Time Conversion

MODULE - III SOLAR GEOMETRY & RADIATION MODELING 8

Solar Geometry Basics - Key Angles: latitude, declination, hour angle, zenith, solar azimuth, angle of incidence - Mathematical Relations - Day Length -

Extraterrestrial Radiation - Terrestrial Radiation - Inclined Surfaces - Radiation Estimation - Prediction Methods

MODULE - IV SOLAR THERMAL CONVERSION SYSTEMS **8**

Solar Collectors - Thermal Basics - Flat Plate Collectors - Evacuated tube collectors: working principle, low-irradiance - advantages - Solar air heaters: configurations and applications • Low-temperature - applications: solar water heating, space heating, solar cookers -Solar Air Heaters - Low-Temp Applications - Medium-Temp Applications - High-Temp Applications - Heat Engine Cycles

MODULE - V SOLAR PHOTOVOLTAIC SYSTEMS & ELECTRICAL CONVERSION **7**

PV Overview - Semiconductor Basics - Photovoltaic Effect - Solar Cell Structure - Electrical characteristics: I-V and P-V curves, Isc, Voc, fill factor, efficiency - MPP - Module, panel, and array configuration: series/parallel connections, bypass diodes - System Components - Performance Ratings - MPPT Basics

MODULE - VI ADVANCED SOLAR APPLICATIONS, INTEGRATION & FUTURE TRENDS **7**

Hybrid Systems - Advanced Applications - Building-integrated photovoltaics (BIPV) principles - Emerging PV technologies: bifacial modules, perovskites, tandem cells - Performance Optimization - Grid Integration - Socio-Technical Aspects - Future Trends

TOTAL : 45 PERIODS

TEXT BOOK:

1. Solar Energy, 4th Edition, 9352607112 · 9789352607112, By S. P. Sukhatme, J K. Nayak, © 2017 Published: August 28, 2017
2. Duffie, J.A. & Beckman, W.A. Solar Engineering of Thermal Processes, Wiley, 2020.
3. Tiwari, G.N. & Tiwari, A. Solar Energy: Fundamentals, Design, Modelling and Applications, Alpha Science, 2017.

REFERENCES:

1. Kalogirou, S. Solar Energy Engineering: Processes and Systems, Academic Press, 2014.

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2. Messenger, R.A. & Ventre, J. Photovoltaic Systems Engineering, CRC Press, 2021.

WEB REFERENCES:

1. https://nptel.ac.in/courses/115107116
2. https://nptel.ac.in/courses/112105050
3. https://nptel.ac.in/courses/103103206

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=iZyzvDj6Y3c
2. https://www.youtube.com/@nptelhrd
3. https://onlinecourses.nptel.ac.in

OUTCOMES:

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

1. Assess solar energy potential and apply solar radiation fundamentals. (K3)
2. Analyze components of solar radiation and measurement methodologies. (K4)
3. Model solar geometry and estimate radiation intensity for diverse orientations. (K3)
4. Evaluate solar-thermal conversion technologies and system design principles. (K4)
5. Design and analyze photovoltaic systems for electrical energy conversion. (K4)
6. Integrate solar solutions into sustainable energy frameworks aligned with SDGs. (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	2
CO2	2	3	-	3	-	2	-	-	-	-	-	2	3
CO3	2	3	-	2	-	2	-	-	-	-	-	2	3
CO4	3	2	-	2	-	3	-	-	-	-	-	3	2
CO5	3	2	-	2	-	3	-	-	-	-	-	3	3
CO6	2	2	-	2	-	3	-	-	-	-	-	2	2

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.

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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 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.

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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

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.

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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)
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

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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

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

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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
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

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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)

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

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 240MEEL518	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	24MEPC302					

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.

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.

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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

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.

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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)
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)

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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
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: 24MEEL519	ERGONOMICS IN DESIGN	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To impart knowledge on the fundamentals of ergonomics.
- To understand the need to ergonomics in industrial design.
- To know the importance of aesthetics and environmental factors in product design.

MODULE - I INTRODUCTION **8**

An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems-Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.

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MODULE - II ERGONOMICS AND PRODUCTION 8

Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.

MODULE - III DESIGN PRINCIPLES FOR DISPLAY 7

Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays.

MODULE - IV DESIGN PRINCIPLES FOR CONTROLS 7

Design of various display Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools.

MODULE - V ENVIRONMENTAL FACTORS 8

Colour: Colour and light, Color and objects, Colour and the eye – after Image, Color blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to color and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style.

MODULE - VI AESTHETIC CONCEPTS 7

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style – The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design.

TOTAL : 45 PERIODS

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TEXT BOOK:

1. Ergonomics in Product Design, 2018 by Sendpoints Publishing Co. Ltd.
2. Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by
3. Marcelo M. Soares , Francisco Rebelo, 2019 by CRC Press.

REFERENCES:

1. Mayall W.H., "Industrial Design for Engineers", London Hiffee Books Ltd., 1988, ISBN 978-1118-02227-6.
2. Brain Shakel (Edited), "Applied Ergonomics Hand Book", Butterworth Scientific,1988. ISBN123-1-118-027-6
3. R. C. Bridger, "Introduction to Ergonomics",McGraw Hill Publications, 1995, ISBN 215-802227-6.
4. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006

WEB REFERENCES:

1. https://ieda.ust.hk/dfaculty/ajay/courses/ieem101/lecs/ergonomics.pdf
2. https://ftp.idu.ac.id/wp-content/uploads/ebook/ip/BUK U%20ERGONOMI/BUKU%20INGGRIS/Ergonomics%20For%20Beginners.pdf

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=LAKlmdMHpdE
2. https://www.youtube.com/watch?v=9_R7M49Atz4
3. https://www.youtube.com/watch?v=SsqPtzFEWys
4. https://www.youtube.com/watch?v=IVRsEf_6H00

OUTCOMES:

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

1. Appreciate the need of ergonomics in the industrial design. (K3)
2. Apply ergonomics in creation of manufacturing system. (K3)
3. Discuss on the design of various methods of display. (K3)
4. Discuss on the design of controls. (K3)
5. Consider environmental factors in ergonomics design. (K3)
6. Report on the importance of aesthetics to manufacturing systems and products. (K3)

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL520	SURFACE ENGINEERING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24MEPC302					

OBJECTIVES:

- To enable the Engineering students about the value of surface engineering
- To make the engineering students to understand the importance of surface & its interactions with its environment
- To equip the students to understand the various & Advanced surface modification techniques
- To develop the skill among the students to evaluate and inspect the surface modified materials for various industrial usages.

MODULE - I FUNDAMENTALS OF SURFACE ENGINEERING 7

Introduction to Surface Engineering – Tribology and Surface Properties – Surface Degradation Mechanisms – Friction and Lubrication – Importance of Surface Modification in Engineering Applications.

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MODULE - II WEAR AND CORROSION MECHANISMS 7

Types of Wear: Adhesive, Abrasive, Oxidative, Corrosive, Erosive and Fretting Wear – Corrosion and its Types – Passivity – Mechanism of Passive Film Growth and Breakdown – Corrosion Prevention and Control Techniques.

MODULE - III SURFACE CLEANING AND PRETREATMENT METHODS 8

Surface Pretreatment of Metallic and Electronic Materials – Mechanical Cleaning and Polishing – Chemical Cleaning Methods – Acid, Alkaline, Acetone and Carbon Tetrachloride Cleaning – Degreasing – Ultrasonic Cleaning – Alumina and Diamond Polishing Techniques.

MODULE - IV SURFACE COATING TECHNIQUES 8

Principles of Surface Coating – Electrodeposition Process and Parameters – Faraday's Laws of Electrodeposition – Industrial Electroplating of Copper, Nickel, Chromium and Gold – Organic Coatings and Paints – Constituents and Formulation of Paints – Enamel and Special Coatings – Heat Resistant and Fire Retardant Paints – Electroless and Conversion Coatings.

MODULE - V ADVANCED SURFACE MODIFICATION PROCESSES 8

Physical Vapour Deposition (PVD) – Chemical Vapour Deposition (CVD) – Ion Beam Processes – Ion Implantation – Reactive Ion Sputtering – Electron Beam Processes – Electron Beam Assisted Vapour Deposition – Laser Assisted Surface Modification – Laser Alloying, Melting and Ablation – Laser Sprayed Deposits and Direct Metal Deposition.

MODULE - VI STANDARDS AND MEASUREMENTS IN SURFACE ENGINEERING 7

Surface Engineering Terminology and Standards – Laboratory Accreditation and Sampling Procedures – Surface Finish Evaluation – Quality Standards for Bare and Coated Materials – Standards for Conversion, Galvanized, Electrodeposited and Vapour Deposited Coatings – ASTM Standards for Surface Measurements – Measurement of Coating Depth, Thickness, Hardness and Friction Coefficient.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Ramnarayan Chattopadhyay, Advanced Thermally Assisted Surface Engineering Processes, Kluwer Academic Publishers, 2004.

Recommended in Board of Studies (BoS) Meeting No. 11 **held on** 8.5.2026

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2. T. S. Sudarshan, Surface Modification Technologies – An Engineer's Guide, Marcel Dekker, New York, 1989.

REFERENCES:

1. C. D. Varghese, Electroplating and Other Surface Treatments – A Practical Guide, Tata McGraw Hill, 1993.
2. Arthur W. Adamson and Alice P. Gast, Physical Chemistry of Surfaces, 6th Edition, John Wiley & Sons, 1997.
3. Stanley J. Dapkunas, Surface Engineering Measurement Standards for Inorganic Materials, National Institute of Standards and Technology, Special Publication 960-9.

WEB REFERENCES:

1. https://datastatresearch.com/courses/surface-engineering-and-coatings-in-manufacturing-training-course
2. https://skillsforafrica.org/in/course/surface-engineering-techniques-training-course
3. https://surfaceengineering.com/resources/
4. https://www.iom3.org/resource/new-online-resource-for-surface-engineering-coatings-sector.html
5. https://dl.asminternational.org/handbooks/edited-volume/20/Surface-Engineering

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mm21
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mm49
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me77
4. https://www.coursera.org/learn/corrosion

OUTCOMES:

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

1. Demonstrate the fundamental concepts of surface engineering, tribology, friction, lubrication, and surface degradation mechanisms. (K3)
2. Analyze various wear and corrosion mechanisms and their effects on engineering materials. (K3)
3. Apply suitable surface cleaning and pretreatment methods for metallic and electronic materials. (K3)

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4. Select appropriate surface coating techniques for improving surface performance in engineering applications. (K3)
5. Assess advanced surface modification processes such as PVD, CVD, ion implantation and laser-based treatments. (K3)
6. Interpret standards, measurements and quality evaluation methods used in surface engineering. (K3)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL521	COMPOSITE MATERIALS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 112104229	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9, 12				
PRE-REQUISITE COURSES	24BSPH202					

OBJECTIVES:

- Understand the concepts of composite materials and their applications.
- To provide an understanding of the manufacturing processes, characteristics and selection and of composite materials.
- To analyze the failure mechanisms and strength of composites under various loading conditions.
- To study the effects of thermal environments on the structural integrity of laminates.

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MODULE - I INTRODUCTION TO COMPOSITE MATERIALS 7

Definition, Classification, Types of matrices and reinforcements, characteristics and selection, Fiber composites, laminated composites, particulate composites, prepegs, sandwich construction. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. iso-strain and iso-stress conditions and application of composites.

MODULE - II MANUFACTURING AND TESTING OF POLYMER MATRIX COMPOSITES 8

Polymers as matrix materials and their classification - Thermoset and thermoplastic matrix materials - Properties - Manufacturing and Testing - Layup and curing - open and closed mould processing - Hand lay-up techniques- Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining, joining and repair. NDT test –Purpose - Types of defects- NDT method - Ultrasonic inspection, Radiography, Acoustic emission and Acoustic ultrasonic method and applications.

MODULE - III MANUFACTURING OF METAL MATRIX AND CERAMIC MATRIX COMPOSITES 8

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

MODULE - IV LAMINA STRENGTH AND FAILURE ANALYSIS 8

Types of Laminates - Symmetric Laminates - Anti symmetric Laminate - Balanced Laminate - Quasi-isotropic Laminates - Cross-ply Laminate - Angle ply Laminate. Orthotropic Laminate, Laminate Moduli - Hydrothermal Stresses. Micromechanics of Failure of Unidirectional Lamina - Anisotropic Strength and Failure Theories - Importance of Shear Strength - Choice of Failure Criteria - Examples.

MODULE - V THERMAL ANALYSIS OF COMPOSITES 7

Assumption of Constant Coefficients of Thermal Expansion (C.T.E) - Modification of Hooke's Law to include thermal effects - Modification of

Laminate Constitutive Equations - Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations - Unidirectional - Off-axis - Symmetric Balanced Laminates - Design of Zero C.T.E laminates and Thermally Quasi-Isotropic Laminates.

MODULE - VI ADVANCES IN COMPOSITES 7

Introduction - Nano composites -Coatings - Carbon fibre composites and Chemical Vapour deposition- Applications of Aircrafts, missiles, space hardware, automobile, electrical and electronics, marine, recreational and sports equipment-future potential of composites.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Mein Schwartz - Mc Graw Hill Book Company - 1984.
2. WD Callister, Jr., Adapted by R. Balasubramaniam, Materials Science and Engineering, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

1. K.K.Chawla, Composite Materials, 3rd Edition, springer, 2012.
2. Deborah D.L. Chung, Composite Materials Science and Applications, 2nd Edition, springer, 2010.
3. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984. 4. 4. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

WEB REFERENCES:

1. https://compositeslab.com/composite-materials/index.html
2. https://www.compositesworld.com/
3. https://wrexham.ac.uk/courses/short-courses/introduction-to-composites/

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_me87/preview
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc19_me67

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OUTCOMES:

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

1. Apply the concepts of composite materials and reinforcement mechanisms in engineering applications.(K3)
2. Demonstrate suitable manufacturing and testing methods for various matrix composites. (K3)
3. Apply fabrication techniques for metal matrix, ceramic matrix, and carbon–carbon composites. (K3)
4. Analyze the strength and failure behavior of composite laminates under different loading conditions. (K3)
5. Evaluate the thermal behavior and coefficient of thermal expansion of composite laminates. (K3)
6. Apply advanced composite materials in aerospace, automobile, marine, and electronic applications. (K3)

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

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL522	SAFETY ENGINEERING AND MANAGEMENT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 110105094	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand the principles of safety engineering in industrial environments
- To identify, evaluate, and control workplace hazards
- To study safety regulations, standards, and risk assessment techniques
- To develop safety management systems for accident prevention
- To analyze industrial accidents and implement corrective measures

MODULE - I INTRODUCTION TO SAFETY ENGINEERING 9

Definition, importance, and scope of safety engineering ,Safety terminology: hazard, risk, accident, incident Industrial safety scenario in India ,Safety laws and regulations (Factories Act, OSHA concepts), Role of safety Engineer

MODULE - II HAZARD IDENTIFICATION AND RISK ASSESSMENT 9

Types of hazards: physical, chemical, biological, ergonomic ,Hazard Identification Techniques (HAZOP, FMEA, JSA) ,Risk assessment methods ,Risk control hierarchy ,Safety audits and inspections

MODULE - III INDUSTRIAL SAFETY MANAGEMENT 9

Safety management systems (SMS) ,Safety policy and organization ,Permit to work system ,Safety training and awareness, Personal Protective Equipment (PPE)

MODULE - IV FIRE AND ELECTRICAL SAFETY 9

Fire triangle and fire classification ,Fire prevention and protection systems ,Fire extinguishers and suppression systems, Electrical hazards and safety practices, Earthing and grounding

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MODULE - V ACCIDENT ANALYSIS AND CONTROL 6

Accident causation theories ,Accident investigation techniques ,Root cause analysis ,Accident reporting and documentation ,Safety performance measurement

MODULE - VI ENVIRONMENTAL AND HEALTH SAFETY 3

Occupational health hazards, Industrial hygiene, Noise, vibration, and radiation control, Environmental safety regulations, Waste management and pollution control

TOTAL : 45 PERIODS

TEXT BOOK:

1. K. K. Chitkara, Construction Project Management, Tata McGraw Hill
2. D. K. Singh, Safety Management in Industry, Pearson Education
3. N. V. Krishnan, Safety in Industry, Jaico Publishing

REFERENCES:

1. Heinrich, H.W., Petersen, D. and Roos, N., Industrial Accident Prevention: A Safety Management Approach, 5th Edition, McGraw-Hill, 2010.
2. Lees, F.P., Lees' Loss Prevention in the Process Industries, 4th Edition, Butterworth-Heinemann, 2012.
3. Goetsch, D.L., Occupational Safety and Health for Technologists, Engineers and Managers, 9th Edition, Pearson Education, 2019.
4. Roughton, J. and Mercurio, J., Developing an Effective Safety Culture, Butterworth-Heinemann, 2014.
5. Hughes, P. and Ferrett, E., Introduction to Health and Safety at Work, 7th Edition, Routledge, 2023.
6. National Safety Council (NSC), Accident Prevention Manual for Business and Industry, NSC Press.
7. Indian Standards Institution (BIS), Safety Standards and Codes for Industrial Operations.
8. ISO 45001:2018 – Occupational Health and Safety Management Systems – Requirements with Guidance for Use.

WEB RESOURCES

1. https://www.osha.gov
2. https://www.nsc.org

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3. https://labour.gov.in
4. https://dgfasli.gov.in
5. https://www.bis.gov.in
6. https://www.ilo.org
7. https://www.cdc.gov/nio

ONLINE RESOURCES:

1. NPTEL Course: Industrial Safety Engineering
2. https://nptel.ac.in
3. SWAYAM Online Courses on Occupational Health and Safety
4. https://swayam.gov.in
5. OSHA e-Tools and Training Resources
6. https://www.osha.gov/etools
7. NIOSH Learning and Training Modules
8. https://www.cdc.gov/niosh
9. DGFASLI Safety Training Modules and Publications
10. https://dgfasli.gov.in
11. Virtual Laboratories (Safety Engineering Simulations)
12. https://www.vlab.co.in
13. ILO Occupational Safety and Health Learning Resources
14. https://www.ilo.org/global/topics/safety-and-health-at-work

OUTCOMES:

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

1. Apply the principles of safety engineering, industrial hazards, safety regulations, and legal requirements applicable to industrial environments.(K3)
2. Identify workplace hazards using appropriate hazard identification techniques and evaluate associated risks.(K3)
3. Apply risk assessment methodologies and implement suitable risk control measures to enhance workplace safety.(K3)
4. Identify industrial accidents using investigation tools and root-cause analysis techniques to recommend preventive actions.(K3)
5. Develop and implement safety management systems, safety policies, permit-to-work systems, and safety training programs.(K3)
6. Apply occupational health, environmental safety, and pollution control practices for sustainable industrial operations.(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	-
CO2	2	3	-	2	-	2	-	-	-	-	-	2	2
CO3	2	3	2	3	2	2	2	-	-	-	-	2	2
CO4	2	3	-	3	-	2	-	-	-	-	-	2	2
CO5	2	2	3	2	2	2	2	-	-	-	2	2	3
CO6	2	2	-	-	-	3	3	-	-	-	-	2	-

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL523	SIX SIGMA QUALITY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand the concepts of six sigma and the goal so fan organization.
- To know the basics of lean principles.
- To learn about design of experiments, statistical process control charts and other related concepts.
- To study about the five phases of six sigma namely define ,measure, analyses, improve and control.

MODULE - I SIX SIGMA FUNDAMENTALS 7

Evolution of Six Sigma – Definition and Objectives – Statistics of Six Sigma: Defects Per Million Opportunities (DPMO), Yield, and Sigma Level – Six Sigma Hierarchy: Yellow, Green, Black, and Master Black Belts – Organizational structure for Six Sigma – Selecting projects – Financial benefits of Six Sigma.

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MODULE - II OVERVIEW OF SIX SIGMA AND THE ORGANIZATION 6

Remember & Understand: Six sigma and organizational goals- Remember & Understand: Lean principles in the organization

MODULE - III MODULE III DEFINE PHASE 9

Apply &Analyze: Process Management for projects - Understand& Apply: Project management basics-Understand & Apply: Management and planning tools -Analyze: Business results for projects - Understand & Apply: Team dynamics and performance

MODULE - IV MEASURE PHASE 9

Analyze: Process analysis and documentation - Understand & Apply: Probabilityandstatistics-Apply,Analyze,Evaluate,&Create:Collectingand summarizing data - Analyze and Evaluate: Measurement system analysis - Analyze& Evaluate: Process capability and performance

MODULE - V ANALYZE PHASE 5

Analyze& Evaluate: Variation and process inputs - Analyze& Evaluate: Data through charts and graphs

MODULE - VI IMPROVE&CONTROLPHASES 9

Understand & Apply: Design of experiments (DOE) -Understand, Apply, and Analyze:Statisticalprocesscontrol(SPC)-Evaluate&Create:Implementand validate solutions Understand &Apply: Assist in developing a control plan to document and hold the gains, and assist in implementing controls and monitoring systems.(Apply)

TOTAL : 45 PERIODS

TEXT BOOK:

1. Munro, R. A., Maio, M. J., Nawaz, M. B., Ramu, G., & Zrymiak, D. J"The CertifiedSix Sigma Green Belt Handbook". Milwaukee, ASQ QualityPress, SecondEdition2015.
2. The Certified Six Sigma Green Belt Handbook – R.A. Munro, M.J. Maio, M.B. Nawaz, G. Ramu and D.J. Zrymiak, ASQ Quality Press, 2015.

REFERENCES:

1. George, M. L., Rowlands, D., Price, M., & Maxey, J "The Lean Six Sigma PocketToolbook",McGraw-Hill,2004.

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2. The Six Sigma Handbook, McGraw-Hill Education, 2018.
3. The Lean Six Sigma Pocket Toolbook, McGraw-Hill, 2004.
4. Juran's Quality Handbook, McGraw-Hill, 7th Edition, 2016.
5. Introduction to Statistical Quality Control, Wiley, 8th Edition, 2020.
6. Design and Analysis of Experiments, Wiley, 10th Edition, 2019.

WEB RESOURCES:

1. NPTEL – Six Sigma Course Portal, https://nptel.ac.in
2. American Society for Quality (ASQ), https://asq.org
3. Six Sigma Council, https://www.sixsigmacouncil.org
4. iSixSigma Knowledge Portal, https://www.isixsigma.com
5. MIT OpenCourseWare – Quality Engineering Resources, https://ocw.mit.edu

ONLINERESOURCES:

1. ASQ Six Sigma Learning Resources, https://asq.org/quality-resources/six-sigma
2. Six Sigma Council Study Guide, https://onlinecourses.nptel.ac.in
3. NPTEL Video Lectures on Quality Engineering, https://ocw.mit.edu
4. MIT OpenCourseWare Quality Systems Materials, https://ocw.mit.edu
5. Lean Enterprise Institute Resources, https://www.lean.org

OUTCOMES:

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

1. Evaluate Six Sigma philosophy, Lean principles, organizational structure, and quality management fundamentals. (K4)
2. Analyze statistical concepts, probability distributions, and quality tools in Six Sigma projects. (K4)
3. Categorize the different define and Measure phases of DMAIC methodology for process characterization and data collection. (K4)
4. Analyze process capability, measurement systems, and statistical process control charts for quality improvement. (K4)
5. Evaluate process variations and identify improvement opportunities using Analyze and Improve phases of DMAIC. (K4)
6. Discover and implement sustainable control plans for maintaining process improvements and organizational excellence. (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
CO2	3	3	2	2	3	-	-	-	-	-	2	2	3
CO3	3	3	2	2	3	-	-	-	2	-	2	2	3
CO4	3	3	2	3	3	-	-	-	-	-	2	2	3
CO5	3	3	3	3	3	-	2	-	2	-	2	2	3
CO6	3	3	3	2	3	-	2	-	2	-	3	3	3

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEEL524	ECONOMICS FOR ENGINEERS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 110105067	SYLLABUS VERSION 1.0	SDG NO. 8, 9, 12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand people, businesses, markets and Government.
- To learn the economic models in domestic and in the global context.
- To critically think about importance of Economics in the Nation's growth.
- To analyse various market factors and also the macro economics outcomes.

MODULE - I INTRODUCTION 8

Introduction to economics-definition-field of economics-Basic fundamental economic concepts-Utility- Value-Consumer and producer goods-Utility-Economic of exchanges-Engineering costs and estimation-types of estimates-Estimating models-Cost indexes-power sizing model, improvement & learning curve.

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MODULE - II MICRO ECONOMICS 8

Meaning–definition–contents of micro economics-demand-factors affecting demand- Supply- factors affecting supply, Market Equilibrium, surplus and shortage- change in equilibrium and changes in supply and demand- Law of supply and demand.

MODULE - III PRODUCTION AND COST 6

Production function and analysis-Cost functions–types of costs-Production possibility curves- Economics of scale- Production –land- labour-Capital- Raw materials- Isoquant- properties.

MODULE - IV INDUSTRY ECONOMICS 8

Industry economics- Break even analysis- Market share- Market performance – Economic Order Quantity –India Industrial growth and pattern-Problems in current Industries-Case study.

MODULE - V MACRO ECONOMICS 8

National income-components–meaning, analysis- circular flow of economy-National income sources-GDP and standard of living-Business cycles-Power of sustainable economic growth.

MODULE - VI INFLATION AND PRICE CHANGE 7

Definition, effects, causes, price change with indexes, types of index, composite Vs. commodity indexes, use of price indexes in engineering economics, analysis, cash flow that inflate at differentrates -Effects of inflation and deflation-Case study-competition in the advertise segment in India.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Panneer Selvam.R,"Engineering Economics", Prentice Hall of India Ltd, NewDelhi,2001.

REFERENCES:

1. Sullivan and Wicks:"Engineering Economy",Pearson publication
2. Desai,B:" Indian Economy in India", Himalaya Publishing House, Mumbai.
3. Nag.A,"Macro Economics for Management Students" MacMillan India Ltd., NewDelhi,2005.

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4. JamesL.Riggs,David D.Bedworth,SabahU.Randhawa:"Economics for Engineers",Tata McGrawHill.
5. JohnA.White,Kenneth E.Case,David B.Pratt:"Principle of Engineering Economic Analysis",John Wiley publication.

WEB REFERENCES:

1. www.economicshelp.org
2. https://data.oecd.org/economy.htm
3. https://www.focus-economics.com
4. www.mospi.gov.in
5. https://www.imf.org/external/

ONLINE RESOURCES:

1. https://www.coursera.org/learn/uva-darden-bcg-pricing-strategy-cost-economics
2. https://www.coursera.org/learn/microeconomics
3. https://www.edx.org/course/fundamentals-of-macroeconomics
4. https://online.stanford.edu/courses/sohs-yeconschool-principles-economics

OUTCOMES:

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

1. Apply fundamental economic concepts, engineering costs, estimation techniques, and their significance in engineering decision-making. (K3)
2. Apply demand-supply analysis, market equilibrium concepts, and engineering economic tools for solving practical economic problems. (K3)
3. Construct production functions, cost structures, economies of scale, and resource utilization in industrial systems. (K3)
4. Develop industrial economic performance using break-even analysis, market share, inventory models, and industry growth indicators. (K3)
5. Interpret macroeconomic indicators such as GDP, national income, inflation, and business cycles to assess economic conditions. (K3)
6. Organize the impact of inflation, price indices, and economic fluctuations on engineering projects and investment decisions. (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	-	-
CO2	3	3	2	2	2	-	-	-	-	-	2	-	2
CO3	2	3	2	2	2	-	-	-	-	-	2	2	2
CO4	2	3	2	2	2	-	-	-	-	-	3	2	2
CO5	2	3	-	2	-	2	2	-	-	-	2	-	-
CO6	2	3	-	2	2	2	2	-	-	-	3	-	-

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24MEIE502	ADVANCED FUEL INJECTION SYSTEM - I	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 1031077125	SYLLABUS VERSION 1.0	SDG NO. 4, 7, 12, 15				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To acquire the knowledge of Advanced Fuel Injection System in Automobiles
- To get on hand experience of such systems.

MODULE - I BASIC CONCEPTS AND FILTER FUNDAMENTALS 5

Basics of Engine, hydraulics of fuel injection system, Low pressure system and CRDI Architecture. Filter, its necessity, types, construction and operation. Filter media, water separation and efficiency of filter.

MODULE - II FILTER MANUFACTURING, CLEANLINESS AND TESTING 4

Process flow of filter manufacturing, importance of cleanliness in filter manufacturing – liquid and mechanical-special steps in filter manufacturing, cleanliness rules and specification,

Assembly and testing of filters.

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MODULE - III RAIL AND RAIL MANUFACTURING. 9

RAIL construction and working, its manufacturing, heat treatment, machining assembling and testing.

MODULE - IV COMMON RAIL PUMPS 9

Pump hydraulics, positive and suction pump, pump design basics, construction, working and

metering, critical geometry and tolerance, RAIL pressure control, assembling and dismantling of pumps and filters.

MODULE - V COMMON RAIL PUMPS MANUFACTURING 9

Process flow of pumps, machining, special processes in pump machining, special finishing processes and testing, pump-RAIL-filter manufacturing, assembly and testing.

MODULE - VI INJECTORS 9

Injectors, types, single and multi-hole, injectors construction and components of injectors, nozzle design and geometry, timings, multiple injectors, cylinder pressure and heat release rate, injector dismantling and reassembly.

TOTAL : 45 PERIODS

TEXT BOOK:

1. V.Ganesan, Internal Combustion Engines, Tata McGraw-Hill, New Delhi.
2. Mathur. R.B. and R.P.Sharma, "Internal Combustion Engines", Dhanpat Rai & Sons 2007.

REFERENCES:

1. John B. Heywood, Internal Combustion Engines Fundamentals, Tata McGraw-Hill, New Delhi.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Wilcox Company, Inc., 1987.

OUTCOMES:

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

1. Apply concepts of engine fundamentals, fuel injection hydraulics, CRDI architecture and filtration systems in automotive applications. [K3]

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2. Implement filter manufacturing processes, cleanliness standards, assembly and testing methods in industrial practice. [K3]
3. Utilize principles of rail construction, manufacturing processes and testing in fuel injection systems. [K3]
4. Apply pump hydraulics, design concepts, pressure control and operational mechanisms of common rail pumps. [K3]
5. Illustrate manufacturing, machining, assembly and testing processes of common rail pump systems. [K3]
6. Describe injector design, construction, performance characteristics and operational analysis in fuel injection systems. [K3]

CO - PO, PSO MAPPING:

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

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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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We build a Better nation through Quality education.

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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