



GOVERNMENT COLLEGE OF ENGINEERING, SALEM
(NAAC Accredited with A+, An Autonomous Institution, Affiliated to Anna University, Chennai)

UNDERGRADUATE CURRICULUM

(Applicable to the students admitted in B.E. Programme, from the Academic Year 2026-2027)

Programme: B.E. Metallurgical Engineering (Full Time)

Regulations: 2026

Overview of Credits

Sem	BS	HM	ES(G)	ES(PC)	ES(PE)	OE	SD	MC	Total
I	12	3	8						23
II	7	3	8				2		20
III	3	2		15				3	23
IV	3			16			1	3	23
V				19	3		1		23
VI				8	9	3	3		23
VII				16	6				22
VIII							10		10
Total	25	8	16	74	18	3	17	6	167
% of Category	14.97	4.79	9.58	44.31	10.78	1.80	10.18	3.59	100

Abbreviations:

Course Type:

T - Theory
L - Laboratory
LIT - Laboratory Integrated Theory
CDP - Capstone Design Project
PW - Project Work
IOC – Industry Oriented Course

Category :

BS - Basic Science
HM - Humanities
ES - Engineering Science [General (**G**)
Programme Core (**PC**)
Programme Elective (**PE**)]
OE - Open Elective
SD - Skill Development
MC - Mandatory Course

Others :

L - Lecture
T - Tutorial
P - Practical
SL - Term work (TW) + Self Learning (SL)
TH - Total Number of Teaching – Learning Hours per Semester

Semester I													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
1.	26MAC01	Matrices and Calculus	T	45	15	0	60	120	4	BS	40	60	100
2.	26ENC01	Communicative English	T	45	0	0	15	60	2	HM	40	60	100
3.	26CYC01	Applied Chemistry	LIT	45	0	45	30	120	4	BS	50	50	100
4.	26PHC01	Applied Physics	LIT	45	0	45	30	120	4	BS	50	50	100
5.	26HMC01	Heritage of Tamil / தமிழர்மரபு	T	15	0	0	15	30	1	HM	40	60	100
6.	26MEC01	Engineering Graphics	T	30	45	0	45	120	4	ES(G)	40	60	100
7.	26CSC01	C Programming	LIT	45	0	30	45	120	4	ES(G)	50	50	100
8.	26MCC01	Induction Programme	T	-	-	-	-	-	0	MC	-	-	-
Total								690	23				

Semester II													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
1.	26MAC02	Ordinary Differential Equations and Transform Techniques	T	45	15	0	60	120	4	BS	40	60	100
2.	26ENC02	Professional English	LIT	30	0	15	15	60	2	HM	50	50	100
3.	26PHC02	Materials Science	T	45	0	0	45	90	3	BS	40	60	100
4.	26HMC02	Tamils and Technology / தமிழரும் தொழில் நுட்பமும்	T	15	0	0	15	30	1	HM	40	60	100
5.	26CEC01	Engineering Mechanics	T	45	15	0	60	120	4	ES(G)	40	60	100
6.	26MEC02	Engineering Practices Laboratory	L	0	0	45	15	60	2	SD	60	40	100
7.	26EEC01	Basic Electrical and Electronics Engineering	LIT	45	0	45	30	120	4	ES(G)	50	50	100
8.	26MCS01	Engineering Sprints	L	0	0	15	15	30	0	SD	100	-	100
9.	26NCC01	NCC Course – I*	T	30	0	0	30	60	2*	-	40	60	100
Total								690	20				

*< Only for NCC Students, it is not considered for CGPA Calculation >

Semester III													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
1.	26MAC04	Partial Differential Equations and Complex Variables	T	45	15	0	30	90	3	BS	40	60	100
2.	26MT301	Physical Metallurgy-I	T	45	0	0	45	90	3	ES(PC)	40	60	100
3.	26MT302	Minerals, Fuels and Furnaces	T	45	0	0	45	90	3	ES(PC)	40	60	100
4.	26MT303	Metallurgical Thermodynamics and Kinetics	T	45	15	0	30	90	3	ES(PC)	40	60	100
5.	26CE307	Mechanics of Deformable Bodies	T	45	15	0	60	120	4	ES(PC)	40	60	100
6.	26MT304	Minerals and Fuels Laboratory	L	0	0	45	15	60	2	ES(PC)	60	40	100
7.	26ENC03	Placement and Soft Skills Laboratory	L	0	0	45	15	60	2	HM	60	40	100
8.	26MCC03	Universal Human Values	T	45	0	0	45	90	3	MC	40	60	100
9.	26MCS02	Innovation Sprints	L	0	0	15	15	30	0	SD	100	-	100
10.	26NCC02	NCC Course – II*	T	30	0	0	30	60	2*	-	40	60	100
Total								780	23				

*< Only for NCC Students, it is not considered for CGPA Calculation >

Semester IV													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
1.	26CY401	Non Metallic Materials	T	45	0	0	45	90	3	BS	40	60	100
2.	26MT401	Mechanical Behaviour and Testing of Materials	T	45	0	0	45	90	3	ES(PC)	40	60	100
3.	26MT402	Physical Metallurgy-II	T	45	0	0	45	90	3	ES(PC)	40	60	100
4.	26MT403	Heat Treatment Technology	T	45	0	0	45	90	3	ES(PC)	40	60	100
5.	26MT404	Iron and Steel Making	T	45	0	0	45	90	3	ES(PC)	40	60	100
6.	26MT405	Metallography Laboratory	L	0	0	45	15	60	2	ES(PC)	60	40	100
7.	26MT406	Materials Testing Laboratory	L	0	0	45	15	60	2	ES(PC)	60	40	100
8.	26MCC02	Environmental Science and Engineering	T	45	0	0	45	90	3	MC	40	60	100
9.	26MTICXX	Industry Oriented Course - I	IOC	15	0	0	15	30	1	SD	100	-	100
10.	26MCC04	Disaster Management and Preparedness	T	30	0	0	30	60	0	MC	100	-	100
11.	26MCS03	Design Sprints	L	0	0	15	15	30	0	SD	100	-	100
Total								780	23				

Semester V													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
1.	26MT501	Transport Phenomena in Metallurgy	T	45	0	0	45	90	3	ES(PC)	40	60	100
2.	26MT502	Metal Casting	T	45	0	0	45	90	3	ES(PC)	40	60	100
3.	26MT503	Metal Forming	T	45	0	0	45	90	3	ES(PC)	40	60	100
4.	26MT504	Metal Joining	T	45	0	0	45	90	3	ES(PC)	40	60	100
5.	26MT505	Corrosion Engineering	T	45	0	0	45	90	3	ES(PC)	40	60	100
6.	26MTPEXX	Programme Elective - I	T	45	0	0	45	90	3	ES(PE)	40	60	100
7.	26MT506	Heat Treatment and Corrosion Laboratory	L	0	0	45	15	60	2	ES(PC)	60	40	100
8.	26MT507	Machine Shop Practice Laboratory	L	0	0	45	15	60	2	ES(PC)	60	40	100
9.	26MTICXX	Industry Oriented Course - II	IOC	15	0	0	15	30	1	SD	100	-	100
10.	26MCC05	Indian Constitution	T	30	0	0	30	60	0	MC	100	-	100
11.	26MCS04	Ideation Sprints	L	0	0	15	15	30	0	SD	100	-	100
Total								780	23				

Semester V													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
For Honours Degree													
1.	26MTD01	Capstone Design Project Level-I	CDP	0	0	90	90	180	6	SD	60	40	100
OR													
1.	26MTHXX	Honours Elective - I	T	45	0	0	45	90	3	ES(PE)	40	60	100
2.	26MTHXX	Honours Elective - II	T	45	0	0	45	90	3	ES(PE)	40	60	100
For Minor Degree													
1.	26MTMXX	Minor Elective - I	T	45	0	0	45	90	3	OE	40	60	100
2.	26MTMXX	Minor Elective - II	T	45	0	0	45	90	3	OE	40	60	100
TOTAL								180	6				

Semester VI													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
1.	26MT601	Non Ferrous Extractive Metallurgy	T	45	0	0	45	90	3	ES(PC)	40	60	100
2.	26MT602	Measurements and Controls	T	45	0	0	45	90	3	ES(PC)	40	60	100
3.	26MTPEXX	Programme Elective - II	T	45	0	0	45	90	3	ES(PE)	40	60	100
4.	26MTPEXX	Programme Elective - III	T	45	0	0	45	90	3	ES(PE)	40	60	100
5.	26MTPEXX	Programme Elective - IV	T	45	0	0	45	90	3	ES(PE)	40	60	100
6.	26XXOEEX	Open Elective - I	T	45	0	0	45	90	3	OE	40	60	100
7.	26MT603	Foundry and Forming Laboratory	L	0	0	45	15	60	2	ES(PC)	60	40	100
8.	26MT604	Mini Project	PW	0	0	45	45	90	3	SD	100	-	100
Total								690	23				

Semester VI													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
For Honours Degree													
1.	26MTD02	Capstone Design Project Level-II	CDP	0	0	90	90	180	6	SD	60	40	100
OR													
1.	26MTHXX	Honours Elective - III	T	45	0	0	45	90	3	ES(PE)	40	60	100
2.	26MTHXX	Honours Elective - IV	T	45	0	0	45	90	3	ES(PE)	40	60	100
For Minor Degree													
1.	26MTMXX	Minor Elective - III	T	45	0	0	45	90	3	OE	40	60	100
2.	26MTMXX	Minor Elective - IV	T	45	0	0	45	90	3	OE	40	60	100
TOTAL								180	6				

Semester VII													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
1.	26MT701	Characterization of Materials	T	45	0	0	45	90	3	ES(PC)	40	60	100
2.	26MT702	Non Destructive Evaluation and Failure Analysis	T	45	0	0	45	90	3	ES(PC)	40	60	100
3.	26MT703	Additive Manufacturing	T	45	0	0	45	90	3	ES(PC)	40	60	100
4.	26MT704	Quality Engineering & Management	T	45	0	0	45	90	3	ES(PC)	40	60	100
5.	26MTPEXX	Programme Elective - V	T	45	0	0	45	90	3	ES(PE)	40	60	100
6.	26MTPEXX	Programme Elective - VI	T	45	0	0	45	90	3	ES(PE)	40	60	100
7.	26MT705	Welding and NDT Laboratory	L	0	0	45	15	60	2	ES(PC)	60	40	100
8.	26MT706	Materials Characterization and Computer Applications Laboratory	L	0	0	45	15	60	2	ES(PC)	60	40	100
Total								660	22				

Semester VII													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
For Honours Degree													
1.	26MTD03	Capstone Design Project Level-III	CDP	0	0	90	90	180	6	SD	60	40	100
OR													
1.	26MTHXX	Honours Elective - V	T	45	0	0	45	90	3	ES(PE)	40	60	100
2.	26MTHXX	Honours Elective - VI	T	45	0	0	45	90	3	ES(PE)	40	60	100
For Minor Degree													
1.	26MTMXX	Minor Elective - V	T	45	0	0	45	90	3	OE	40	60	100
2.	26MTMXX	Minor Elective - VI	T	45	0	0	45	90	3	OE	40	60	100
TOTAL								180	6				

Semester VIII													
Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
1.	26MT801	Project Work	PW	0	0	225	75	300	10	SD	60	40	100
TOTAL								300	10				
Total Credits of the Programmes									167				

Programme Electives

Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
Programme Elective - I													
1.	26MTPE01	Powder Metallurgy	T	45	0	0	45	90	3	ES(PE)	40	60	100
2.	26MTPE02	Fractography and Failure Analysis	T	45	0	0	45	90	3	ES(PE)	40	60	100
3.	26MTPE03	Metallurgical Kinetics	T	45	0	0	45	90	3	ES(PE)	40	60	100
4.	26MTPE04	Solidification Processing	T	45	0	0	45	90	3	ES(PE)	40	60	100
5.	26MTPE05	Fracture Mechanics	T	45	0	0	45	90	3	ES(PE)	40	60	100
Programme Elective - II													
6.	26MTPE06	Non Ferrous Alloys	T	45	0	0	45	90	3	ES(PE)	40	60	100
7.	26MTPE07	Processing of Composite Materials	T	45	0	0	45	90	3	ES(PE)	40	60	100
8.	26MTPE08	Processing of Ceramic Materials	T	45	0	0	45	90	3	ES(PE)	40	60	100
9.	26MTPE09	Bio and Smart Materials	T	45	0	0	45	90	3	ES(PE)	40	60	100
10.	26PSC01	Applied Design Thinking	T	45	0	0	45	90	3	ES(PE)	40	60	100

Programme Elective - III													
11.	26MTPE10	Metallurgy of Castings	T	45	0	0	45	90	3	ES(PE)	40	60	100
12.	26MTPE11	Special Casting Technology	T	45	0	0	45	90	3	ES(PE)	40	60	100
13.	26MTPE12	Alternate routes of Iron Making	T	45	0	0	45	90	3	ES(PE)	40	60	100
14.	26MTPE13	Secondary Steel Making	T	45	0	0	45	90	3	ES(PE)	40	60	100
15.	26PSC02	Startup Fundamentals	T	45	0	0	45	90	3	ES(PE)	40	60	100
Programme Elective - IV													
16.	26MTPE14	Metallurgy of Welding	T	45	0	0	45	90	3	ES(PE)	40	60	100
17.	26MTPE15	Severe Plastic Deformation	T	45	0	0	45	90	3	ES(PE)	40	60	100
18.	26MTPE16	Metallurgical Waste Utilization and Management	T	45	0	0	45	90	3	ES(PE)	40	60	100
19.	26MTPE17	Computational Materials Engineering	T	45	0	0	45	90	3	ES(PE)	40	60	100
20.	26MTPE18	Special Welding Processes	T	45	0	0	45	90	3	ES(PE)	40	60	100
Programme Elective - V													
21.	26MTPE19	Electrical, Electronics and Magnetic Materials	T	45	0	0	45	90	3	ES(PE)	40	60	100
22.	26MTPE20	X-ray Diffraction and Electron Microscopy	T	45	0	0	45	90	3	ES(PE)	40	60	100
23.	26MTPE21	Novel Materials	T	45	0	0	45	90	3	ES(PE)	40	60	100
24.	26MTPE22	Advanced Surface Engineering	T	45	0	0	45	90	3	ES(PE)	40	60	100
25.	26MTPE23	Materials for automotive industry	T	45	0	0	45	90	3	ES(PE)	40	60	100
Programme Elective - VI													
26.	26MTPE24	Nano Materials	T	45	0	0	45	90	3	ES(PE)	40	60	100
27.	26MTPE25	Thin Film Coatings and Applications	T	45	0	0	45	90	3	ES(PE)	40	60	100
28.	26MTPE26	Aerospace Materials	T	45	0	0	45	90	3	ES(PE)	40	60	100
29.	26MTPE27	Modelling and Simulation in Material Processes	T	45	0	0	45	90	3	ES(PE)	40	60	100
30.	26MTPE28	Nuclear Materials	T	45	0	0	45	90	3	ES(PE)	40	60	100

Open Electives

Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
Courses Offered by the Department of Civil Engineering													
1.	26CEOE01	Environmental Management	T	45	0	0	45	90	3	OE	40	60	100
2.	26CEOE02	Repair and Rehabilitation of Building Elements	T	45	0	0	45	90	3	OE	40	60	100
3.	26CEOE03	Mechanics of Deformable Bodies	T	45	0	0	45	90	3	OE	40	60	100
Courses Offered by the Department of Computer Science and Engineering													
1.	26CSOE01	Object Oriented Programming Concepts	T	45	0	0	45	90	3	OE	40	60	100
2.	26CSOE02	Operating Systems Principles	T	45	0	0	45	90	3	OE	40	60	100
3.	26CSOE03	Python Programming	T	45	0	0	45	90	3	OE	40	60	100
4.	26CSOE04	Fundamentals of Java Programming	T	45	0	0	45	90	3	OE	40	60	100
5.	26CSOE05	Data Structures using C	T	45	0	0	45	90	3	OE	40	60	100
6.	26CSOE06	Introduction to Artificial Intelligence	T	45	0	0	45	90	3	OE	40	60	100
7.	26CSOE07	Cloud Computing Fundamentals	T	45	0	0	45	90	3	OE	40	60	100
Courses Offered by the Department of Electronics and Communication Engineering													
1.	26ECOE01	Fundamentals of Electron Devices	T	45	0	0	45	90	3	OE	40	60	100
2.	26ECOE02	Principles of Modern Communication Systems	T	45	0	0	45	90	3	OE	40	60	100
3.	26ECOE03	Microcontrollers and Its Applications	T	45	0	0	45	90	3	OE	40	60	100
4.	26ECOE04	Basics of Embedded Systems	T	45	0	0	45	90	3	OE	40	60	100
5.	26ECOE05	Basics of Internet of Things	T	45	0	0	45	90	3	OE	40	60	100

Sl. No.	Course Code	Course Name	Course Type	Hours per Semester					Credits	Category	Weightage		
				L	T	P	SL	TH			CA %	ES %	Total
Courses Offered by the Department of Electrical and Electronics Engineering													
1.	26EEOE01	Renewable Energy Systems	T	45	0	0	45	90	3	OE	40	60	100
2.	26EEOE02	Industrial Drives	T	45	0	0	45	90	3	OE	40	60	100
3.	26EEOE03	Electrical Energy Conservation and Management	T	45	0	0	45	90	3	OE	40	60	100
4.	26EEOE04	Fundamentals of Electric Vehicle	T	45	0	0	45	90	3	OE	40	60	100
5.	26EEOE05	Electrical Safety and Energy Auditing	T	45	0	0	45	90	3	OE	40	60	100
6.	26EEOE06	Energy Storage Systems and its Applications	T	45	0	0	45	90	3	OE	40	60	100
Courses Offered by the Department of Mechanical Engineering													
1.	26MEOE01	Design of Machine Elements and Machining	T	45	0	0	45	90	3	OE	40	60	100
2.	26MEOE02	Internal Combustion Engines	T	45	0	0	45	90	3	OE	40	60	100
3.	26MEOE03	Refrigeration and Air conditioning	T	45	0	0	45	90	3	OE	40	60	100
4.	26MEOE04	Power Plant Engineering	T	45	0	0	45	90	3	OE	40	60	100
5.	26MEOE05	Hydraulics and Pneumatics	T	45	0	0	45	90	3	OE	40	60	100
6.	26MEOE06	Industrial Engineering and Management	T	45	0	0	45	90	3	OE	40	60	100
7.	26MEOE07	Renewable Energy Sources	T	45	0	0	45	90	3	OE	40	60	100
8.	26MEOE08	Robotics and Automation	T	45	0	0	45	90	3	OE	40	60	100
9.	26MEOE09	Total Quality Management	T	45	0	0	45	90	3	OE	40	60	100
10.	26MEOE10	Automotive Systems	T	45	0	0	45	90	3	OE	40	60	100
Courses Offered by the Department of Metallurgical Engineering													
1.	26MTOE01	Foundry and Welding Technology	T	45	0	0	45	90	3	OE	40	60	100
2.	26MTOE02	Surface Engineering	T	45	0	0	45	90	3	OE	40	60	100
3.	26MTOE03	Design and Selection of Materials	T	45	0	0	45	90	3	OE	40	60	100
4.	26MTOE04	Nano Science and Technology	T	45	0	0	45	90	3	OE	40	60	100
5.	26MTOE05	Materials for Automobile Components	T	45	0	0	45	90	3	OE	40	60	100
6.	26MTOE06	Metallurgy for Non-metallurgist	T	45	0	0	45	90	3	OE	40	60	100

List of Honours Courses

Sl.No.	Course Code	Course Name
1.	26MTH01	Advanced Metal Joining Processes
2.	26MTH02	Metallurgy of Welding
3.	26MTH03	Welding Equipment and consumables
4.	26MTH04	Welding codes and standards
5.	26MTH05	Automation and Robotics
6.	26MTH06	Welding Application Technology
7.	26MTH07	Brazing, Soldering, Surfacing and Cutting
8.	26MTH08	Design of Weldments
9.	26MTH09	Failure Analysis in Weldments

List of Minors Courses

Sl.No.	Course Code	Course Name
1	26MTM01	Advanced Physical Metallurgy
2	26MTM02	Metallurgical Thermodynamics and Kinetics
3	26MTM03	Mechanical Behaviour of Materials
4	26MTM04	Rate Processes in Metallurgy
5	26MTM05	Corrosion and Surface Engineering
6	26MTM06	Characterization of Materials
7	26MTM07	Automotive, Aerospace and Defence Materials

26MAC01		MATRICES AND CALCULUS B.E. (Common to all Branches Except EEE)		SEMESTER			I		
Prerequisites				Category	BS	Credits		4	
Basic 12th level Matrices, Differential Calculus and Integral Calculus.				Hours/ Semester	L	T	P	SL	TH
					45	15	-	60	120
COURSE OBJECTIVES									
1.	To understand the fundamental concepts of matrices, eigen values, eigen vectors, diagonalization and quadratic forms for solving algebraic and engineering problems.								
2.	To develop knowledge in functions of several variables, partial differentiation, Jacobians, and optimization techniques involving maxima, minima and Lagrange multipliers.								
3.	To apply techniques of integral calculus, including differentiation under the integral sign, Leibnitz rule, and Beta and Gamma functions in the evaluation of integrals.								
4.	To acquire problem-solving skills in double and triple integrals, change of variables and applications related to area and volume computations.								
5.	To understand and apply vector calculus concepts such as gradient, divergence, curl, line, surface, and volume integrals along with Green's, Stoke's and Gauss divergence theorems in mathematical and engineering applications.								
UNIT - I		MATRICES							9+3
Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors– Cayley– Hamilton theorem (excluding proof) – Diagonalization of matrices – Reduction of Quadratic form to canonical form by using orthogonal transformation – Nature of a Quadratic form.									
UNIT - II		FUNCTIONS OF SEVERAL VARIABLES							9+3
Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Jacobians – Taylor's formula for two variables– Maxima and Minima of functions of two variables – Lagrange's method of undermined multipliers.									
UNIT - III		INTEGRAL CALCULUS							9+3
Differentiation under integrals – Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions– Properties – Evaluation of single integrals by using Beta and Gamma functions.									
UNIT - IV		MULTIPLE INTEGRALS							9+3
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals.									
UNIT - V		VECTOR CALCULUS							9+3
Gradient of a scalar field, directional derivative – Divergence and Curl – Solenoidal and Irrotational vector fields – Line integrals over a plane curve – Surface integrals – Area of a curved surface – Volume Integral – Green's theorem, Stoke's and Gauss divergence theorems (without proofs)– Verification and applications in evaluating line, surface and volume integrals.									
L:45, T:15, SL :60, Total:120 Hours									
Weightage:									
Continuous Assessment: 40%									
End Semester Examinations: 60%									

TEXT BOOKS:				
1.	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 45 th Edition, New Delhi, 2020.			
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10 th Edition, Wiley India Pvt Ltd., New Delhi, 2018.			
REFERENCE BOOKS:				
1.	James Stewart, Daniel K Clegg & Saleem Watson, "Calculus with Early Transcendental Functions", Cengage Learning, 6 th Edition, New Delhi, 2023.			
2.	Joel Hass, Christopher Heil, Maurice D.Weir, "Thomas' Calculus", 14 th Edition, Pearson Education, New Delhi, 2018.			
3.	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5 th Edition, New Delhi, 2017.			
E-RESOURCES:				
1.	NPTEL, "Engineering Mathematics-I", National Programme on Technology Enhanced Learning, https://www.nptel.ac.in/courses/111105121			
2.	MIT OpenCourseWare, "Single Variable Calculus and Multivariable Calculus", Massachusetts Institute of Technology, https://ocw.mit.edu/courses/18-02sc-multivariable-calculus-fall-2010/			
3.	Khan Academy, "Linear Algebra and Multivariable Calculus", https://www.khanacademy.org/math/linear-algebra , https://www.khanacademy.org/math/multivariable-calculus			
4.	Paul's Online Math Notes, "Calculus III and Linear Algebra", Lamar University, https://tutorial.math.lamar.edu/Classes/CalcIII/CalcIII.aspx			
5.	Wolfram MathWorld, "Mathematics Resource", Wolfram Research, https://mathworld.wolfram.com/topics/VectorCalculus.html			
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Remember and understand the fundamental concepts and methods in matrices, functions of several variables, integral calculus, multiple integrals and vector calculus including eigen values and eigen vectors, Cayley–Hamilton theorem, quadratic forms, partial derivatives, Jacobians, maxima and minima, Beta and Gamma functions, double and triple integrals, gradient, divergence, curl and Green's, Stoke's and Gauss divergence theorems.		--	--
CO2	Apply the concepts and techniques of matrices, functions of several variables, integral calculus, multiple integrals and vector calculus to solve mathematical and engineering problems involving eigen values and quadratic forms, optimization of multivariable functions, evaluation of integrals using Beta and Gamma functions, computation of areas and volumes through multiple integrals and evaluation of line, surface, and volume integrals using Green's, Stoke's and Gauss divergence theorems.		PO1	PSO1
CO3	Analyze mathematical and engineering problems using the principles of matrices, functions of several variables, integral calculus, multiple integrals and vector calculus by interpreting eigen values and quadratic forms, examining extrema of multivariable functions, selecting suitable integration techniques, transforming multiple integrals using coordinate changes and analyzing vector fields through divergence, curl and integral theorems.		PO2	PSO1

C04	Design and develop mathematical solution strategies using matrices, multivariable calculus, multiple integrals, and vector calculus techniques for solving engineering problems related to optimization, coordinate transformations, area and volume computations and vector field analysis.	PO3	PS02
C05	Communicate and interpret mathematical results effectively by applying appropriate mathematical representations, analytical methods and vector integral theorems in solving practical and engineering-oriented problems.	PO10	PS02
C06	Utilize mathematical and computational techniques from matrices, multivariable calculus, integral calculus, multiple integrals, and vector calculus to model, interpret and solve real-world engineering and scientific problems effectively.	PO5	PS02

The Course Articulation Matrix (CAM) for defined COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
C01														
C02	3											3		
C03		2										2		
C04			1										2	
C05										3			2	
C06					3								2	
Avg	3	2	1		3					3		2.5	2	

Activities:

1.	Mathematical Presentation and Report Writing on Engineering Applications of Vector Calculus (C05) Students can choose one application-based problem from vector calculus such as work done by a force field, flux through a surface, verification of Green's theorem, Stoke's theorem or Gauss divergence theorem. They should solve it step by step, interpret the answer and present it with proper mathematical notation, diagram and short report.
2.	Computational Exploration of Matrices, Multiple Integrals, and Vector Fields using Software (C06) Students can use Python, GeoGebra or any open-source mathematical software to solve and visualize problems. Examples include finding eigen values and eigen vectors, diagonalization, plotting functions of two variables, evaluating double/triple integrals, plotting vector fields, and interpreting gradient, divergence and curl.

Rubrics for evaluation: C05

Sl. No.	Criterion	Marks	Excellent (7-8)	Good (4-6)	Satisfactory (1-3)
1.	Selection and understanding of problem	8	Application-oriented problem is clearly selected and concept is correctly explained	Problem is selected properly, but explanation needs minor improvement	Problem selection is basic and conceptual understanding is limited

2.	Mathematical formulation and solution	8	Correct formulation, step-by-step solution and proper use of formulae/theorems	Formulation and solution are mostly correct with minor errors	Formulation is incomplete and solution contains several errors
3.	Interpretation of results	8	Results are clearly interpreted with physical or engineering meaning	Results are interpreted, but explanation is not detailed enough	Interpretation is weak or unclear
4.	Communication, presentation and report writing	8	Neat presentation with correct notation, diagrams and well-structured report	Presentation is understandable, but needs improvement in notation or organization	Presentation is poorly organized and mathematical communication is unclear
5.	Overall analytical approach	8	Work demonstrates excellent analytical thinking and professional academic approach	Analytical approach is good with minor limitations	Analytical approach is satisfactory but lacks depth
	Total	40			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (7-8)	Good (4-6)	Satisfactory (1-3)
1.	Use of computational tool	8	Appropriate software/tool is selected and used effectively	Tool is used properly, but with minor limitations	Use of tool is limited or not clearly demonstrated
2.	Accuracy of computation and mathematical method	8	Computations are accurate and mathematical method is correctly applied	Computations are mostly correct with minor errors	Computations contain significant errors or method is unclear
3.	Visualization and interpretation	8	Graphs, plots, matrices, vector fields or integral regions are clearly visualized and interpreted	Visualization is given, but interpretation needs improvement	Visualization is incomplete or interpretation is unclear
4.	Report preparation and conclusion	8	Report has objective, procedure, output, interpretation and conclusion	Report is acceptable, but needs better structure or explanation	Report is incomplete or poorly structured
5.	Overall presentation and analytical quality	8	Work demonstrates excellent analytical approach and professional presentation	Analytical quality and presentation are good with minor issues	Analytical quality is satisfactory but lacks depth
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24	-	-	24	3
C03	16	16	-	-	16	2
C04	8	8	-	-	8	1
C05	-	-	40	-	25	3
C06	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26ENC01	COMMUNICATIVE ENGLISH B.E. (Common to all Branches)		SEMESTER				I/II
Prerequisites		Category	HM	Credits			2
Basic language skills listening, speaking, reading and writing		Hours/ Semester	L	T	P	SL	TH
			45	-	-	15	60
COURSE OBJECTIVES							
1.	To develop integrated Listening, Speaking, Reading, and Writing (LSRW) skills for academic and professional communication.						
2.	To enable learners to comprehend, interpret, and respond to spoken and written texts in technical and workplace contexts.						
3.	To strengthen the use of grammar, vocabulary, and language structures for accurate communication.						
4.	To enhance learners' oral communication skills for discussions, presentations, interviews, and workplace interactions.						
5.	To develop learners' ability to analyze, summarize, report, recommend, and interpret information from texts and real-world data.						
UNIT - I COMMUNICATION BASICS							
Listening: Listening to simple conversations, Understanding tone and intent. Speaking: Narrating personal experience and events, Expressing opinions. Reading: Reading for comprehension and specific information, Understanding notices, messages, timetables, graphs etc. Writing: Dialogue writing in a business context. Grammar: Parts of speech - Nouns, Pronouns, Verbs – Main verbs, auxiliary verbs, modal verbs, Adverbs.							
UNIT - II WORKPLACE COMMUNICATION							
Listening: Listening to short speeches and TED talks, Extracting information. Speaking: Informal conversation between office colleagues, asking for information to fill details in a form. Reading: Reading technical texts from journals, newspapers and technical blogs. Writing: Writing checklists, Writing recommendations. Grammar: Parts of speech – Adjectives, Conjunctions, Prepositions, Interjections.							
UNIT - III INTERACTIVE COMMUNICATION							
Listening: Listening to debates and discussions, Different viewpoints on an issue. Speaking: Role play - customer and sales manager, team leader and team member, interviewer and applicant. Reading: Reading technical description of gadgets – learning the different parts of devices. Writing: Writing instructions, Writing E-mails - Attending workshops, Paper submission for conferences, Arranging a meeting. Grammar: Synonyms, Antonyms, Redundancies, Collocations.							
UNIT - IV PROFESSIONAL WRITING							
Listening: Listening to documentaries depicting a technical problem and suggesting solutions. Speaking: Giving a speech, Describing given data, Discussing company information, Summarizing an article. Reading: Reading longer technical texts, Reading biographies and travelogues. Writing: Paragraph writing – Different types of paragraphs, Report Writing – Status reports, Feasibility reports and event reports. Grammar: Conditional statements, Compound words, Sentence completion, Negation in statements and questions.							

UNIT - V		INTERPRETATION		9
Listening: Listening to informal communication and longer technical talks.				
Speaking: Qualities required for employability, Improving employee’s productivity, teamwork, creativity and leadership quality.				
Reading: Reading brochures, telephone messages, social media messages relevant to technical contexts.				
Writing: Mind maps, Charts - interpreting statistical data, charts, graphs and tables.				
Grammar: One word substitution, Abbreviations and acronyms in technical context, Technical vocabulary, Idioms.				
L:45, SL:15, Total:60 Hours				
Weightage:				
Continuous Assessment - 40%				
End Semester Examinations - 60%				
REFERENCE BOOKS:				
1.	Sharma, S., and B. Mishra. <i>Communication Skills for Engineers and Scientists</i> . 2nd ed., PHI Learning, 2024.			
2.	Miller, Katherine Q., and Susan T. Wahl. <i>Business and Professional Communication: KEYSfor Workplace Excellence</i> . 5th ed., SAGE Publications, 2023.			
3.	Viswamohan, Aysha. <i>English for Technical Communication</i> . McGraw-Hill Education, 2013.			
4.	Raman, Meenakshi, and Sangeeta Sharma. <i>Technical Communication: Principles andPractice</i> . 3rd ed., Oxford University Press, 2015.			
5.	Rizvi, M. Ashraf. <i>Effective Technical Communication</i> . McGraw Hill Education India, 2017.			
E-RESOURCES:				
1.	https://learnenglish.britishcouncil.org/			
2.	https://www.bbc.co.uk/learningenglish/			
3.	https://www.ted.com/talks			
4.	https://www.cambridgeenglish.org/			
5.	https://www.toastmasters.org/			
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Explain the fundamentals of listening, speaking, reading, and writing (LSRW) skills for effective academic and workplace communication.		PO9, PO11	
CO2	Apply appropriate grammar, vocabulary, sentence structures, and language conventions to communicate accurately in technical and professional contexts.		PO9, PO11	
CO3	Demonstrate effective oral communication skills through discussions, presentations, interviews, debates, and workplace interactions with confidence and clarity.		PO9, PO11	PSO1
CO4	Analyze technical and professional texts, reports, charts, and workplace documents to interpret, summarize, and present relevant information effectively.		PO9, PO11	
CO5	Develop professional writing skills for drafting reports, emails, proposals, status reports, feasibility reports, and other workplace documents.		PO9, PO10, PO11	PSO3
CO6	Integrate communication, interpersonal, and leadership skills in real-life and workplace situations while demonstrating ethical, social, and professional responsibility.		PO8, PO9, PO11	PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
C01									3		2			
C02									3		2			
C03									3		2	1		
C04									3		2			
C05									3	2	2			2
C06								2	3		2			2

Activities:

1.	C05: Develop professional writing skills for drafting reports, emails, proposals, status reports, feasibility reports, and other workplace documents. (i) Technical Report Writing Project: Prepare a detailed technical report based on a case study, industrial visit, survey, or mini project including abstract, findings, analysis, and recommendations. (ii) Business Proposal Development: Design and present a professional proposal for a startup idea, product launch, campus initiative, or technical solution addressing real-world problems. (iii) Workplace Email: Draft formal emails, circulars, notices for different workplace situations such as complaints, negotiations, approvals, and scheduling. (iv) Feasibility and Status Report Preparation: Analyze a technical or business scenario and prepare feasibility reports and periodic status reports using charts, data interpretation, and recommendations. (v) Collaborative Documentation Activity: Work in teams to create project documentation including meeting minutes, progress reports, executive summaries, and client communication records.
2.	C06: Integrate communication, interpersonal, and leadership skills in real-life and workplace situations while demonstrating ethical, social, and professional responsibility. (i) Group Discussion and Leadership Role Play: Participate in team-based discussions where students rotate as leader, moderator, presenter, and evaluator to solve workplace problems. (ii) Mock Interview and HR Interaction: Attend simulated HR, technical, and panel interviews focusing on communication, confidence, interpersonal behaviour, and professional ethics. (iii) Corporate Meeting Simulation: Conduct formal meetings involving agenda preparation, negotiation, conflict resolution, decision-making, and presentation of outcomes. (iv) Community Outreach / Social Responsibility Project: Attend workshops, organize awareness campaigns, literacy drives, environmental programs, or social initiatives emphasizing teamwork, leadership, and ethical responsibility. (v) Problem-Solving Case Study Presentation: Analyze real-time workplace or ethical case studies and present solutions collaboratively using leadership, communication, and decision-making skills.

Rubrics for evaluation: C05

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Understanding of Purpose and Audience	10	Clearly identifies the purpose, context, and target audience; content is highly relevant	Purpose and audience are identified with minor gaps in relevance	Purpose and audience are inadequately addressed
2.	Content Development and Organization	10	Content is comprehensive, logically organized, and professionally structured	Content is organized with minor omissions or inconsistencies	Content lacks organization and completeness
3.	Professional Writing and Communication	10	Uses appropriate tone, style, and workplace conventions effectively	Generally appropriate tone and style with minor errors	Tone, style, or workplace conventions are inappropriate or unclear
4.	Language, Formatting, and Accuracy	10	Excellent grammar, vocabulary, formatting, and document presentation with no significant errors	Minor grammatical, formatting, or language errors	Frequent errors in grammar, formatting, and presentation affecting readability
	Total	40			

Rubrics for evaluation: C06

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Communication Skills	10	Communicates ideas clearly, confidently, and effectively using appropriate verbal and non-verbal communication	Communicates ideas adequately with minor clarity or delivery issues	Communication is unclear, hesitant, or ineffective
2.	Interpersonal and Teamwork Skills	10	Demonstrates excellent collaboration, active listening, respect for others, and conflict resolution skills	Participates effectively in teamwork with occasional guidance	Limited participation and difficulty in working with others
3.	Leadership and Decision-Making	10	Shows initiative, responsibility, problem-solving ability, and effective leadership in group activities	Demonstrates leadership qualities with minor limitations	Shows limited initiative and leadership ability
4.	Ethical, Social, and Professional Responsibility	10	Consistently demonstrates ethical behaviour, professionalism, accountability, and social responsibility	Demonstrates responsibility and professionalism with minor lapses	Shows inadequate awareness of ethical or professional responsibilities
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12			12	2
C02	24	24			24	3
C03	12	12			12	2
C04	12	12			12	2
C05			40		20	2
C06				40	20	2
Total	60	60	40	40	100	

Note: Purely as an example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26CYC01	APPLIED CHEMISTRY			SEMESTER			I	
Prerequisites			Category	BS	Credits		4	
Basic Chemistry concepts			Hours/ Semester	L	T	P	SL	TH
				45	-	45	30	120
COURSE OBJECTIVES								
1.	To understand the fundamental scientific principles related to water chemistry, electrochemical systems, polymers, acid–base equilibria, corrosion phenomena, and spectroscopic techniques used in engineering applications.							
2.	To acquire the ability to apply chemical laws, numerical methods, and analytical reasoning for solving engineering problems involving water quality, electrochemical cells, buffer systems, corrosion, and instrumental analysis.							
3.	To examine the behaviour of chemical and material systems and interpret the influence of process parameters on performance in water treatment, electrochemical processes, corrosion control, polymers, and spectroscopy.							
4.	To assess different engineering materials, chemical processes, and analytical techniques for selecting suitable methods in industrial and technological applications.							
5.	To develop practical laboratory skills by performing experiments related to water analysis, electrochemistry, polymers, acid–base systems, corrosion studies, and spectroscopic measurements, and to interpret experimental data effectively.							
UNIT - I		WATER TECHNOLOGY:					9+9	
Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – dissolved oxygen significance – boiler troubles (scale and sludge, priming and foaming, caustic embrittlement and boiler corrosion) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – demineralization, zeolite process – desalination of brackish water – reverse osmosis.								
Practical: 1. Estimation of total hardness by EDTA method. 2. Estimation of alkalinity of water.								
Activities: 1. Determination of DO by Winkler titration. 2. Coagulation of water by adding alum.								
UNIT - II		ELECTROCHEMISTRY:					9+9	
Cells – types – Electrochemical cell – representation of electrochemical cell – redox reaction – single electrode potential – oxidation and reduction potential – Nernst equation for single electrode potential – numerical problems. Electrochemical series – significance and application – measurement of emf of cell – poggendorff's method. Potentiometric titrations (acid-base, redox and precipitation titrations).								
Practical: 1. Estimation of iron by potentiometric titration. 2. Estimation of strong acid by conductometric titration. 3. Estimation of mixture of acids by conductometric titration.								
Activity: Electrochemical cell demonstration								
UNIT - III		POLYMERS AND PHASE RULE:					9+9	
Polymers – definition – polymerization – types – addition and condensation polymerization – mechanism of free radical addition polymerization – plastics, classification – thermosetting and thermo plastic – preparation, properties and uses of PVC, Teflon, polyurethane, nylon-6,6, PET.								
Phase rule – Introduction, definition of terms with examples, one component system – water system.								
Practical: Determination of molecular weight of polymer by viscometry.								
Activity: Comparing biodegradable and non-biodegradable polymers.								

UNIT - IV	ACID BASE CONCEPTS AND CORROSION:	9+9
Acids and bases – Arrhenius concept – Bronsted-Lowry concept – Lewis concept – pH and pKa – buffer solutions – types – mechanism of buffer action – Henderson–Hasselbalch equation – derivation and problems. Corrosion – causes – types of corrosion – chemical, electrochemical corrosion (galvanic, differential aeration) – factors influencing the rate of corrosion – electrochemical protection – sacrificial anode method and impressed current cathodic method. Practical: 1. Estimation of strong acid by pH meter. 2. Estimation of pKa of weak acid by pH meter. Activities: 1. Using litmus paper finding out the nature (acid or base) of household substances. 2. Corrosion study by weight loss method		
UNIT - V	SPECTROSCOPIC TECHNIQUES:	9+9
Beer-Lambert's law (problem) – UV visible spectroscopy: Principle, chromophore, auxochrome, electronic transitions and instrumentation (No applications). Flame photometry – principle – instrumentation – estimation of sodium by flame photometer. Atomic absorption spectroscopy – principle – instrumentation – estimation of nickel by atomic absorption spectroscopy. Practical: 1. Estimation of iron by spectrophotometer. 2. Estimation of copper by calorimeter. Activity: Determining chlorophyll content in leaves with a spectrophotometer.		
L:45, P:45, SL:30, Total:120 Hours		
Weightage: Continuous Assessment 50% End Semester Examinations 50%		
REFERENCE BOOKS:		
1.	S. S. Dara and S. S. Umare, —A Textbook of Engineering Chemistry S. Chand & Company LTD, New Delhi, 2015	
2.	P. C. Jain and Monika Jain, —Engineering Chemistry Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015	
3.	S. Vairam, P. Kalyani and Suba Ramesh, —Engineering Chemistry Wiley India PVT, LTD, New Delhi, 2013.	
4.	Dr.Shashi Chawla - A Textbook of Engineering Chemistry - Dhanpat Rai & Co. (Pvt.) Ltd., New Delhi - 2001	
5.	Dr. O. G. Palanna - Engineering Chemistry - McGraw-Hill Education (India) Private Limited - 2009	
E-RESOURCES:		
1.	www.onlinecourses.nptel.ac.in/	
2.	www.ePathshala.nic.in	
3.	eGyanKosh – IGNOU Repository (http://egyankosh.ac.in) – ID: 123456789/43343	
4.	Royal Society of Chemistry Education (https://edu.rsc.org)	
5.	MIT OpenCourseWare (https://ocw.mit.edu)	

COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Explain the fundamental principles of water chemistry, electrochemical systems, polymers, phase equilibria, acid–base concepts, corrosion processes, and spectroscopic techniques relevant to engineering applications.	---	---
CO2	Apply chemical laws, mathematical relationships, and analytical methods to solve engineering problems related to water quality analysis, electrochemical systems, buffer solutions, corrosion, and spectroscopic measurements.	PO1	---
CO3	Analyze chemical systems and engineering problems by correlating theoretical principles with material behaviour, process performance, and experimental observations in water treatment, electrochemistry, corrosion, polymers, and spectroscopy.	PO2	---
CO4	Perform laboratory experiments based on water quality parameters, electrochemical processes, polymer properties, acid–base equilibria, corrosion mechanisms, and spectroscopic analysis.	PO4, PO8	---
CO5	Execute activity-based investigations related to water analysis, acid–base systems, corrosion studies, polymer characterization, and spectroscopic techniques, and interpret the results using standard analytical methods.	PO5, PO8	---
CO6	Engage in self-learning activities to understand and explore the role of chemical principles, materials, and analytical techniques in water treatment, corrosion control, polymers, electrochemical systems, and spectroscopy, and present the findings in engineering applications.	PO9, PO11	---

The Course Articulation Matrix (CAM) for defined COs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1														
CO2	2													
CO3		2												
CO4				3				3						
CO5					2			2						
CO6									2		2			

Activities:

1.	Undertake experimental studies and virtual/self-learning activities on water treatment, acid–base systems, corrosion, polymers, and spectroscopy, and report the observations and conclusions. (CO5) (Individual and Collaborative Team Work)
2.	Engage in self-learning and evaluated through quizzes, case studies, seminars, and presentations on the application of chemical principles, materials, and analytical techniques in engineering systems. (CO6) (Independent study)

Rubrics for evaluation:CO5

Sl. No	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Understanding of Concept	10	Understanding of the concept with clear explanations.	Understanding with minor errors or omissions.	Shows basic understanding but with significant gaps or misconceptions.
2.	Team Participation and Collaboration	10	Actively contributes, collaborates effectively, and supports team members throughout the activity.	Participates regularly and contributes to team tasks with moderate involvement.	Limited participation and contribution to team activities.
3.	Interpretation of Results	10	Results are accurately analyzed, clearly interpreted, and well justified using scientific principles.	Results are interpreted correctly with some justification.	Basic interpretation of results with limited analysis or justification.
4.	Response to Questions	10	Answers questions accurately and effectively.	Answers most questions correctly.	Answers questions with partial accuracy.
	Total	40			

Rubrics for evaluation:CO6

Sl. No	Criterion	Marks	Excellent (4)	Good(3)	Satisfactory (2)
1.	Conceptual Clarity and Knowledge	10	Shows complete conceptual clarity with strong understanding and accurate knowledge.	Shows good conceptual clarity with minor errors.	Basic understanding with limited clarity and several gaps.
2.	Accuracy of Content / Answers	10	All answers are correct, precise, and scientifically accurate.	Most answers are correct with minor mistakes.	Some correct answers but several errors present.
3.	Application and Analytical Thinking	10	Effectively applies concepts to solve problems and analyze situations.	Applies concepts with minor difficulty in analysis.	Limited ability to apply concepts; mostly descriptive.
4.	Participation and Preparedness	10	Fully prepared, actively participates, and demonstrates strong engagement throughout the activity.	Well prepared and participates actively with minor gaps.	Partially prepared with limited participation or engagement.
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Theory Component				Laboratory Component		Percentage allocation	Mapping Strength
	Test I	Test II	Activity I	Activity II	Observation and Record	Test		
C01	12	12					6	1
C02	24	24					12	2
C03	24	24					12	2
C04					100	100	50	3
C05			40				10	2
C06				40			10	2
Total	60	60	40	40	100	100	100	

Note:Purely as anExample: Strength = 3 (if percentage >20%);

Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26PHC01	APPLIED PHYSICS				SEMESTER				I	
Prerequisites					Category	BS	Credits			4
					Hours/ Semester	L	T	P	SL	TH
						45	-	45	30	120
COURSE OBJECTIVES										
1.	To understand the fundamental principles of mechanics and rotational motion.									
2.	To analyze ultrasonic wave production, detection, and applications.									
3.	To develop conceptual understanding of quantum mechanics and nanoscale systems.									
4.	To understand the fundamental principles of laser operation, laser characteristics and different types of laser.									
5.	To understand the principles of optical fiber transmission and communication system for high-speed data transmission.									
UNIT - I		MECHANICS								9+9
Rotation of rigid bodies: Rotational kinematics – Rotational kinetic energy and moment of inertia – Theorems of moment of inertia – Moment of inertia of diatomic molecule – Torque – Rotational dynamics of rigid bodies – Conservation of angular momentum – Rotational energy state of a rigid diatomic molecule – gyroscope – Torsional pendulum – Introduction to nonlinear oscillations. Practical: 1. Torsional Pendulum – Determination of rigidity modulus of the given material 2. Determination of moment of inertia of a rigid body Activity: Virtual demonstration of Gyroscopic Motion										
UNIT - II		ULTRASONICS								9+9
Properties - Production: Magnetostriction effect - Magnetostriction generator - Piezoelectric effect – Piezoelectric generator – Detection of ultrasonic waves - Cavitation– Acoustical grating– Velocity measurement – Industrial Applications: SONAR – Non Destructive Testing: Pulse echo system through transmission and reflection modes – Medical application - Sonogram Practical: 1. Ultrasonic interferometer – Determination of velocity of ultrasonic waves and compressibility of given liquid 2. Acoustical Grating - Determination of velocity of ultrasonic waves in a given liquid Activity: Virtual demonstration of SONAR.										
UNIT - III		QUANTUM MECHANICS								9+9
Matter waves – Experimental evidence - Davisson and Germer experiment – Schrodinger’s wave equation - Time independent and dependent equations – Physical significance of wave function – Normalization – Particle in an infinite potential well (1D) – Tunnelling effect (Qualitative) – Scanning Tunnelling Microscope (STM). Practical: 1. Quantum Mechanics of Particle in a Potential Well – simulation 2. Quantum tunnelling through a potential barrier – simulation Activity: Virtual demonstration of Scanning Tunnelling Microscope										
UNIT - IV		LASER								9+9
Characteristics of laser light – absorption, spontaneous emission and stimulated emission – Einstein Co-efficient (derivation) – Population inversion – Pumping methods – Types of laser – Construction and working of Nd:YAG laser, CO ₂ Laser, Semiconductor laser (homojunction and heterojunction) – Industrial and medical applications (Qualitative).										

Practical: 1. Determination of wavelength of laser using grating 2. Determination of particle size using laser Activity: Virtual demonstration of semiconductor laser				
UNIT - V	FIBRE OPTICS		9+9	
Principle of optical fibre – Structure – Critical angle – Propagation of light through optical fibre – Numerical aperture and Acceptance angle – Classification of optical fibre – Fibre optic communication (Block diagram) – Fibre optic sensors: Displacement and Temperature Sensor - Medical Application- Fibre optic endoscope. Practical: 1. Determination of Acceptance angle and Numerical aperture of a given fibre 2. Determination of displacement using fibre optics sensor Activity: Virtual demonstration of fibre optic sensors				
L:45, P:45, SL:30, Total:120 Hours				
Weightage: Continuous Assessment 50% End Semester Examinations 50%				
TEXT BOOKS:				
1.	A. Marikani, 'Engineering Physics', PHI Learning Publishers, 2024.			
2.	M.Arumugam, 'Engineering Physics', Anuradha Publications, 2014.			
3.	R.K. Gaur & S.L. Gupta, 'Engineering physics', Dhanpat Rai Publications, 2022.			
4.	B.B. Laud, 'Lasers and Non-linear Optics', New Age international Publishers, 2021.			
REFERENCE BOOKS:				
1.	H.D. Young & R.A. Freedman, 'University physics with modern physics', Pearson, 2020.			
2.	Arthur Beiser, 'Concepts of Modern Physics', McGraw-Hill, 2017.			
3.	K. Thyagarajan and Ajoy Ghatak, ' <i>Lasers: Theory and Applications</i> ', Springer, 2012.			
E-RESOURCES:				
1.	Ultrasonics: https://nptel.ac.in/courses/122107035			
2.	CO ₂ Laser: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ph03			
3.	Quantum Mechanics: https://www.youtube.com/playlist?list=PL0F530F3BAF8C6FCC			
4.	Optical Sensors: https://auece.digimat.in/nptel/courses/video/108106173/L02.html			
COURSE OUTCOMES (COs) At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Explain the fundamental principles and concepts of applied physics and their engineering applications.		--	
CO2	Apply physics principles to solve problems encountered in engineering context		PO1	
CO3	Analyse the solution strategies for applied physics problems, selecting appropriate approaches based on theoretical and practical considerations.		PO2	
CO4	Perform practical experiments and activity-based demonstrations in groups and present the observed results.		PO4, PO8	
CO5	Communicate emerging concepts and advancements in physics while considering environmental sustainability and societal impact through virtual laboratory activities and seminar presentations.		PO6, PO9	PSO3

CO6	Engage in self-learning to explore emerging physics concepts, advanced technologies, and contemporary engineering applications, fostering continuous professional development.										PO11				
The Course Articulation Matrix (CAM) for defined COs															
	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3	
CO1															
CO2	2														
CO3		3													
CO4				3				3							
CO5						2			2					2	
CO6											2				
Activities:															
1.	Determination of physics concepts through virtual lab. (CO5) Seminar presentation of emerging physics concepts. (CO5)														
2.	Self-learning study and presentation on emerging physics-based technologies with safety considerations. (CO6)														
Rubricsforevaluation (CO5)															
Sl. No.	Criterion		Marks	Excellent (3)		Good (2)		Satisfactory (1)							
1.	Subject Knowledge		10	Clearly explains the concept with relevant examples		Good explanation with minor gaps		Basic understanding of the topic							
2.	Content Organization		10	Information is well-organized, clear, and logically presented		Organization is good with minor improvements needed		Average organization of content							
3.	Communication Skills		10	Confident presentation with clear explanation and effective response to questions		Good communication with slight hesitation		Basic communication skills							
4.	Interpretation of Results		10	Results are accurately analyzed, clearly interpreted, and well justified using scientific principles.		Results are interpreted correctly with some justification		Basic interpretation of results with limited analysis or justification.							
	Total		40												
Rubricsforevaluation (CO6)															
Sl. No.	Criterion		Marks	Excellent (3)		Good (2)		Satisfactory (1)							
1.	Topic Understanding		10	Clearly explains the concept and its real-world application with relevant details		Good explanation with minor gaps		Basic understanding of the topic							

2.	Literature Review	10	Reviews and compares multiple relevant research articles effectively	Reviews relevant articles with some comparison	Limited review of articles
3.	Analysis & Interpretation	10	Critically analyses the product performance, advantages, and limitations	Good analysis with minor shortcomings	Basic analysis provided
4.	Presentation & Communication	10	Well-organized report/presentation with clear communication and proper references	Organized presentation with minor errors	Average presentation and communication
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

	Theory Component				Laboratory Component		Percentage allocation	Mapping Strength
CO	Test I	Test II	Activity I	Activity II	Observation and Record	Test		
CO1	12	12					6	1
CO2	24	24					12	2
CO3	24	24			40	40	32	3
CO4					60	60	30	3
CO5			40				10	2
CO6				40			10	2
Total	60	60	40	40	100	100	100	

Note: Strength = 3 (if percentage >20%); Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26HMC01	தமிழர் மரபு B.E. (Common to all Branches)		பருவம்		I
முன்நிபந்தனைகள்		Category	HM	Credits	
இலக்கணம் மற்றும் இலக்கியத்தின் அடிப்படைகள்		Hours/ Semester	L	T	P
			15	-	-
				SL	TH
				15	30
பாடநெறி நோக்கங்கள்					
1.	தமிழ் மொழி மற்றும் இலக்கியம் பற்றிய அறிவைப் பெற முடியும்.				
2.	பாரம்பரியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் மற்றும் சிற்பக் கலைகள் பற்றி தெரிந்து கொள்ள முடியும்.				
3.	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் பற்றி அறிந்து கொள்ள முடியும்.				
4.	தமிழர்களின் ஒழுக்க நெறிமுறைகளைப் பற்றி தெரிந்து கொண்டு அதன்படி நடந்து கொள்ள முடியும்.				
5.	பழங்கால இந்திய தேசிய இயக்கம் பற்றியும், இந்திய மக்களின் பண்பாட்டில் தமிழர்களின் பங்களிப்பு பற்றியும் நன்கு அறிந்து கொள்ள முடியும்.				
அலகு - I		மொழி மற்றும் இலக்கியம்:			3
இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் -சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர் தல் அறம் - திருக்குறளில் மேலாண்மை கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம் , ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி- தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.					
அலகு - II		மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை			3
நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள் , பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம் ,பறை, வீணை, யாழ் , நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.					
அலகு - III		நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்			3
தெருக்கூத்து, கரகாட்டம் , வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம் , வளரி, புலியாட்டம் , தமிழர்களின் விளையாட்டுகள்.					
அலகு - IV		தமிழர்களின் திணைக் கோட்பாடுகள்			3
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்கொப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு -சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர் களின் வெற்றி.					

அலகு - V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3
இந்திய விடுதலை போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.		
L:15, SL :15, Total:30 Hours		
மதிப்பீட்டு விகிதம்: தொடர் மதிப்பீடு: 40% பருவ இறுதித் தேர்வுகள்: 60%		
குறிப்புநூல்கள்:		
1.	தமிழக வரலாறு - மக்களும் பண்பாடும்- கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)	
2.	கணினித் தமிழ்- முனைவர் இல. சுந்தரம்(விகடன் பிரசுரம்)	
3.	கீழடி- வைகை நதிகரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு)	
4.	பொருநை- ஆற்றங்கரை நாகரீகம் (தொல்லியல் துறை வெளியீடு)	
5.	முத்திராமலிங்கம் சு. & சரவணகுமார் மு. "தமிழர் மரபு (Heritage of Tamils)", 2023 Yes Dee Publishing Pvt. Ltd., சென்னை.	
மின்னணுவளங்கள்:		
1.	https://en.wikipedia.org/wiki/Dravidian_languages	
2.	https://www.tamilvu.org/courses/degree/	
3.	https://www.scribd.com/document/802136891/Heritage-of-Tamils	
4.	https://www.scribd.com/document/718189396/AKAM-AND-PURAM	
5.	https://pmc.ncbi.nlm.nih.gov/articles/PMC10357311/	
பாடநெறி முடிவுகள் (COs) / இந்தப் படிப்பு முடிந்ததும், மாணவர்களால்		Mapping POs
CO1	இந்திய மொழிகள், மொழிக் குடும்பங்கள், இலக்கியத்தின் தோற்றம் மற்றும் வளர்ச்சி ஆகியவற்றை விளக்குவதோடு, தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்புகளை மதிப்பிடுவார்கள்.	PO9
CO2	பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை தமிழர்களின் கலை மரபுகளை அறிந்து, தமிழர்களின் சமூக மற்றும் பொருளாதார வாழ்வில் கோவில்களின் பங்கை விளக்குவார்கள்.	PO9
		Mapping PSOs

C03	தமிழர்களின் வாழ்வியல் முறைகளோடு தொடர்புடைய நாட்டுப்புறக் கலைகள், வீர விளையாட்டுகள் மற்றும் சங்ககாலத் திணைக் கோட்பாடுகளைப் புரிந்துகொண்டு அவற்றின் பண்பாட்டு முக்கியத்துவத்தை எடுத்துரைப்பார்கள்.	PO9	PSO1
C04	இந்திய தேசிய இயக்கத்திலும் இந்தியப் பண்பாட்டு வளர்ச்சியிலும் தமிழர்களின் பங்களிப்பை ஆய்ந்து அதன் வரலாற்றுச் சிறப்பை விளக்குவார்கள்.	PO9	-
C05	இந்திய மொழிகள், இலக்கிய வளர்ச்சி, தமிழ் இலக்கிய அறிஞர்களின் பங்களிப்புகள், சங்ககாலத் திணைக் கோட்பாடுகள் ஆகியவற்றை அடிப்படையாகக் கொண்டு கருத்தரங்குகள், விளக்கவுரைகள், குழு விவாதங்கள் மற்றும் திட்டப்பணிகளை மேற்கொண்டு தங்களது பகுப்பாய்வுத் திறனை வெளிப்படுத்துவார்கள்.	PO9, PO11	PSO3
C06	தமிழர்களின் கலை, பண்பாடு, நாட்டுப்புறக் கலைகள், வீர விளையாட்டுகள், கோவில் மரபுகள் மற்றும் தேசிய இயக்கத்தில் தமிழர்களின் பங்களிப்பு தொடர்பான களஆய்வு, ஆவணப்படுத்தல், படைப்பாற்றல் செயல்பாடுகள் மற்றும் வழங்கல்களின் மூலம் பண்பாட்டு விழிப்புணர்வு மற்றும் ஆய்வுத் திறன்களை வளர்த்துக் கொள்வார்கள்.	PO9, PO11	PSO3

வரையறுக்கப்பட்ட பாடக் கற்றல் விளைவுகளுக்கான பாட ஒருங்கிணைப்பு அட்டவணை (CAM)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
C01									3					
C02									3					
C03									3			2		
C04									3					
C05									3		2			2
C06									3		2			2

செயல்பாடுகள்:

1.	C05: தமிழர்களின் பாரம்பரிய அறிவியல் அறிவு, தொழில்நுட்பச் சாதனைகள் மற்றும் பண்பாட்டு மரபுகளை ஆராய்ந்து, அவற்றின் வரலாற்று மற்றும் தற்கால முக்கியத்துவத்தைப் புரிந்துகொள்வார்கள். செயல்பாடுகள்: - பழந்தமிழர்களின் அறிவியல் மற்றும் தொழில்நுட்பச் சாதனைகள் (எ.கா., நீர்ப்பாசன அமைப்புகள், கட்டிடக்கலை, உலோகவியல், கடல்சார் வாணிபம்) குறித்த கருத்தரங்கு வழங்கல். - பாரம்பரியத் தமிழ் அறிவு முறைகளின் தற்காலப் பயன்பாடு மற்றும் முக்கியத்துவம் குறித்த குழு விவாதம். - தமிழர் பண்பாட்டு மரபுச் சின்னங்கள், வரலாற்று நினைவுச் சின்னங்கள் மற்றும் பொறியியல் அற்புதங்கள் தொடர்பான வழக்குக் கள ஆய்வு (Case Study Analysis).
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	4. தமிழர்களின் பண்பாட்டு மற்றும் தொழில்நுட்பப் பங்களிப்புகளை எடுத்துக்காட்டும் வகையில் விளக்கப்படங்கள், மாதிரிகள் மற்றும் புகைப்படங்களைக் கொண்டு பாரம்பரியக் கண்காட்சி நடத்துதல், தமிழர் இலக்கியம், அறிவியல் மற்றும் பண்பாட்டுச் சாதனைகள் குறித்த வினாடி வினா மற்றும் பட்டிமன்றம் / விவாதம் நடத்துதல். 5. அருங்காட்சியகங்கள், பாரம்பரியத் தளங்கள், கோவில்கள் அல்லது தொல்லியல் தளங்களுக்கு களப்பயணம் மேற்கொண்டு ஆய்வறிக்கை சமர்ப்பித்தல்.				
2.	CO6: தமிழர்களின் அறிவியல், தொழில்நுட்ப மற்றும் பண்பாட்டுப் பங்களிப்புகளின் பயன்பாடுகளையும் அவற்றின் தற்காலப் பொருத்தத்தையும் செயல்வழிக் கற்றல், வழக்குக் கள ஆய்வுகள் மற்றும் திட்டப்பணிகள் மூலம் வெளிப்படுத்துவார்கள். செயல்பாடுகள்: 1. தமிழர்களின் பாரம்பரியத் தொழில்நுட்பங்கள் (நீர் மேலாண்மை, வேளாண் முறைகள், பாரம்பரியக் கட்டிடக்கலை போன்றவை) தொடர்பான சிறு திட்டப்பணி (Mini Project) மேற்கொள்ளுதல். 2. தமிழர் பொறியியல் சாதனைகளை (எ.கா., கல்லணை, கோவில் கட்டிடக்கலை, பண்டைய கடற்படைக் கப்பல்கள்) விளக்கும் மாதிரி வடிவமைத்தல் (Model Making Activity). 3. பண்டைய தமிழர் தொழில்நுட்பங்களையும் நவீன தொழில்நுட்பங்களையும் ஒப்பிட்டு வழக்குக் கள ஆய்வு வழங்கல் (Case Study Presentation) மேற்கொள்ளுதல். 4. பாரம்பரியக் கலைகள், கைவினைப் பொருட்கள், நாட்டுப்புற நடைமுறைகள் அல்லது பூர்வீகத் தொழில்நுட்பங்கள் தொடர்பான செயல்விளக்கக் காட்சி (Practical Demonstration) நடத்துதல். தமிழர்களின் அறிவியல் மற்றும் தொழில்நுட்பப் பங்களிப்புகளை எடுத்துரைக்கும் சுவரொட்டி (Poster) மற்றும் தகவல் விளக்கப்படம் (Infographic) தயாரித்தல், உள்ளூர் பாரம்பரிய அறிவு, நாட்டுப்புறப் பழக்கவழக்கங்கள் அல்லது பண்பாட்டு மரபுகள் தொடர்பான சமூக அடிப்படையிலான ஆய்வுத் திட்டம் மேற்கொண்டு அதன் முடிவுகளை வழங்குதல்.				
CO5-க்கான மதிப்பீட்டு அளவுகோல்கள்					
வரி சை எண்	மதிப்பீட்டு அளவுகோல்	மதிப் பெண் கள்	மிகச் சிறப்பு (7-8)	சிறப்பு (4-6)	திருப்திகரம் (1-3)
1.	தமிழர் பாரம்பரியம் குறித்த அறிவு	8	தமிழர்களின் அறிவியல், தொழில்நுட்ப மற்றும் பண்பாட்டு மரபுகள் குறித்து துல்லியமான விவரங்களுடன் விரிவான புரிதலை வெளிப்படுத்துகிறார்.	சிறிய குறைபாடுகளுட ன் நல்ல புரிதலை வெளிப்படுத்துகி றார்	வரையறுக்கப்பட் ட விவரங்களுடன் அடிப்படைப் புரிதலை வெளிப்படுத்துகி றார்

2.	வரலாற்றுப் புரிதல்	8	வரலாற்றுப் பின்னணி மற்றும் அதன் முக்கியத்துவத்தை பொருத்தமான எடுத்துக்காட்டுகளுடன் தெளிவாக விளக்குகிறார்.	சில எடுத்துக்காட்டுகளுடன் வரலாற்றுப் பின்னணியை விளக்குகிறார்.	வரலாற்றுப் பின்னணியை குறைந்த அளவில் விளக்குகிறார்
3.	தற்காலப் பொருத்தம்	8	பாரம்பரிய அறிவு மற்றும் சாதனைகளை இன்றைய பயன்பாடுகள் மற்றும் பிரச்சினைகளுடன் திறம்பட தொடர்பு படுத்துகிறார்.	பாரம்பரிய அறிவை நவீன பயன்பாடுகளுடன் ஒரளவு தெளிவாக தொடர்பு படுத்துகிறார்.	சில நவீன தொடர்புகளை மட்டுமே அடையாளம் காண்கிறார்.
4.	வழங்கல் மற்றும் தொடர்புத் திறன்	8	தகவல்கள் சிறப்பாக ஒழுங்கமைக்கப்பட்டு, தெளிவாகவும் சுவாரஸ்யமாகவும் பொருத்தமான ஆதாரங்களுடன் வழங்கப்படுகின்றன	தகவல்கள் ஒழுங்கமைக்கப்பட்டு பெரும்பாலும் தெளிவாக வழங்கப்படுகின்றன.	தகவல்கள் புரிந்துகொள்ளக் கூடியதாக இருந்தாலும் தெளிவு மற்றும் ஒழுங்கமைப்பு குறைவாக உள்ளது.
5.	தொடர்புத் திறன்	8	கருத்துகள் தெளிவாகவும், தன்னம்பிக்கையுடனும், ஈர்க்கக்கூடிய வகையிலும், பொருத்தமான ஆதாரங்களுடன் வெளிப்படுத்தப்படுகின்றன.	கருத்துகள் தெளிவாகவும், மிதமான தன்னம்பிக்கையுடனும், போதுமான ஆதாரங்களுடனும் வெளிப்படுத்தப்படுகின்றன	கருத்துப் பரிமாற்றம் புரிந்துகொள்ளக் கூடியதாக இருந்தாலும், தெளிவு, தன்னம்பிக்கை அல்லது பொருத்தமான ஆதாரங்களின் குறைபாடு காணப்படுகிறது
	மொத்தம்	40			

CO6-க்கான மதிப்பீட்டு அளவுகோல்கள்

வரி சை எண்	மதிப்பீட்டு அளவு கோல்	மதிப் பெண் கள்	மிகச் சிறப்பு (7-8)	சிறப்பு (4-6)	திருப்திகரம் (1-3)
1.	அறிவின் பயன்பாடு	8	தமிழர்களின் அறிவியல், தொழில்நுட்ப மற்றும் பண்பாட்டுக் கருத்துக்களை செயல்வழிப் பணிகள் மற்றும் திட்டங்களில் திறம்படப் பயன்படுத்துகிறார்.	கருத்துக்களை சிறிய வழிகாட்டுதலுடன் சரியாகப் பயன்படுத்துகிறார்.	கருத்துக்களை அடிப்படை அளவில் மட்டுமே பயன்படுத்துகிறார்.
2.	திட்டப்பணி செயல்படுத்தல்	8	திட்டப்பணி முழுமையானதாகவு ம், புதுமையானதாகவும், சிறந்த திட்டமிடலுடன் வெற்றிகரமாக நிறைவேற்றப்பட்டதாகவும் உள்ளது.	திட்டப்பணி சிறிய குறைபாடுகளுடன் நன்கு செயல்படுத்தப்பட்டுள்ளது.	திட்டப்பணி குறைந்தபட்ச தேவைகளைப் பூர்த்தி செய்கிறது; ஆனால் ஆழமும் முழுமையும் குறைவாக உள்ளன.
3.	ஆதாரங்கள் மற்றும் வளங்களின் பயன்பாடு	8	திட்டத்தின் முடிவுகளை ஆதரிக்க பொருத்தமான தரவுகள், ஆதாரங்கள் மற்றும் எடுத்துக்காட்டுகளை திறம்படப் பயன்படுத்துகிறார்.	போதுமான ஆதாரங்களுடன் பொருத்தமான வளங்களைப் பயன்படுத்துகிறார்.	குறைந்த அளவிலான ஆதாரங்கள் மற்றும் வளங்களைப் பயன்படுத்துகிறார்.
4.	வழங்கல் மற்றும் ஆவணப்படுத்தல்	8	முடிவுகளைத் தெளிவாகவும் தொழில்முறை முறையிலும் சிறப்பான ஆவணப்படுத்தலுடன் வழங்குகிறார்.	நல்ல ஆவணப்படுத்தலுடன் தெளிவாக வழங்குகிறார்.	வழங்கல் மற்றும் ஆவணப்படுத்தல் போதுமானதாக இருந்தாலும் தெளிவும் விவரங்களும் குறைவாக உள்ளன.

5	ஆவணப்படுத்தலின் தரம்	8	ஆவணப்படுத்தல் முழுமையானதாகவும், துல்லியமானதாகவும், நன்கு ஒழுங்கமைக்கப்பட்டதாகவும், சரியான வடிவமைப்புடன் அமைந்ததாகவும் உள்ளது.	ஆவணப்படுத்தல் முழுமையாகவும், சிறிய விடுபாடுகளுடன் ஒழுங்கமைக்கப்பட்டதாகவும் உள்ளது.	ஆவணப்படுத்தல் போதுமானதாக இருந்தாலும், விவரம், துல்லியம் அல்லது சரியான ஒழுங்கமைப்பு ஆகியவற்றில் குறைபாடுகள் காணப்படுகின்றன.
	மொத்தம்	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24			24	3
C03	12	12			12	2
C04	12	12			12	2
C05			40		20	2
C06				40	20	2
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26HMC01	HERITAGE OF TAMILS B.E. (Common to all Branches)		SEMESTER				I	
Prerequisites			Category	HM	Credits			1
Basics of Tamil Language and Literature.			Hours/ Semester	L	T	P	SL	TH
				15	-	-	15	30
COURSE OBJECTIVES								
1.	To obtain the knowledge of Tamil Language and Literature.							
2.	To familiarize with painting and Sculpture.							
3.	To know about the folks and martial arts.							
4.	To understand the Thinaï concept of Tamils.							
5.	To know about the contribution of Tamils to Indian National Movement and Indian Culture.							
UNIT - I		LANGUAGE AND LITERATURE						3
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.								
UNIT - II		HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE						3
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.								
UNIT - III		FOLK AND MARTIAL ARTS						3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.								
UNIT - IV		THINAI CONCEPT OF TAMILS						3
Lora and Fauna of Tamils, Aham and Puram Concepts from Tholkappiyam and Sangam Literature-Aram Concept of Tamils, Education and Literacy during the Sangam Age. Ancient Cities and Ports of the Sangam Age, Export and Import during the Sangam Age Overseas Conquests of the Cholas.								
UNIT - V		CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE						3
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.								
L:15, SL :15, Total:30 Hours								
Weightage:								
Continuous Assessment: 40%								
End Semester Examinations: 60%								

REFERENCE BOOKS:

1. Dr. K. K. Pillay., "Social Life of Tamils" A joint publication of TNTB & ESC and RMRL – (in print)
2. Dr. S. Singaravelu., "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies Publications.
3. "Porunai Civilization", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation Publications, Tamil Nadu.
4. "Keeladi-Sangam City Civilization on the banks of river Vaigai", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation Publications, Tamil Nadu.
5. "Heritage of Tamils", Muthuramalingam S and Dr Saravanakumar. M, Yes Dee Publication, 2023.

E-RESOURCES:

1. https://en.wikipedia.org/wiki/Dravidian_languages
2. <https://www.tamilvu.org/courses/degree/>
3. <https://www.scribd.com/document/802136891/Heritage-of-Tamils>
4. <https://www.scribd.com/document/718189396/AKAM-AND-PURAM>
5. <https://pmc.ncbi.nlm.nih.gov/articles/PMC10357311/>

COURSE OUTCOMES (COs) /**At the end of the course, the students will have the ability to****Mapping
POs****Mapping
PSOs****CO1**

Acquire knowledge of Tamil language, literature and the Thina concepts that reflect the cultural and ecological wisdom of the Tamils.

PO9

-

CO2

Familiarize with the artistic heritage of the Tamils through the study of painting, sculpture, folk traditions and martial arts.

PO9

-

CO3

Understand the contributions of Tamils to Indian culture, society and the national movement.

PO9

PSO1

CO4

Develop an appreciation of Tamil civilization, its cultural practices, artistic achievements, and enduring values in shaping Indian heritage.

PO9

-

CO5

Examine the traditional scientific knowledge, technological achievements, and cultural heritage of the Tamils and understand their historical and contemporary significance.

PO9, PO11

PSO3

CO6

Demonstrate the applications and relevance of Tamil scientific, technological and cultural contributions through practical activities, case studies and project-based work.

PO9, PO11

PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1									3					
CO2									3					
CO3									3			2		
CO4									3					
CO5									3		2			2
CO6									3		2			2

Activities:

1.	CO5: Examine the traditional scientific knowledge, technological achievements, and cultural heritage of the Tamils, and understand their historical and contemporary significance. Seminar Presentation on ancient Tamil scientific and technological achievements (e.g., irrigation systems, architecture, metallurgy, maritime trade). Group Discussion on the relevance of traditional Tamil knowledge systems in modern society. Case Study Analysis of Tamil cultural heritage sites, monuments, and engineering marvels. Heritage Exhibition displaying charts, models, and photographs related to Tamil cultural and technological contributions, Quiz and Debate on Tamil literary, scientific, and cultural achievements. Field Visit to museums, heritage sites, temples or archaeological locations and submission of a report.
2.	CO6: Demonstrate the applications and relevance of Tamil scientific, technological, and cultural contributions through practical activities, case studies, and project-based work. Mini Project on traditional Tamil technologies such as water management, agricultural practices, or indigenous architecture. Model Making Activity depicting Tamil engineering achievements (e.g., Kallanai Dam, temple architecture, ancient ships). Case Study Presentation comparing ancient Tamil technologies with contemporary technologies. Practical Demonstration of traditional arts, crafts, folk practices, or indigenous techniques. Community-Based Project documenting local traditional knowledge, folk practices, or cultural heritage and presenting the findings, Digital Portfolio Development showcasing project outcomes, photographs, reports, and reflections on Tamil heritage and technology.

Rubrics for evaluation:CO5

Sl. No.	Criterion	Marks	Excellent (7-8)	Good(4-6)	Satisfactory (1-3)
1.	Knowledge of Tamil Heritage	8	Demonstrates comprehensive understanding of Tamil scientific, technological, and cultural heritage with accurate details.	Demonstrates good understanding with minor omissions.	Demonstrates basic understanding with limited details

2.	Historical Understanding	8	Clearly explains historical context and significance with relevant examples.	Explains historical context with some supporting examples.	Provides limited explanation of historical context.
3.	Contemporary Relevance	8	Effectively relates traditional knowledge and achievements to present-day applications and issues.	Relates traditional knowledge to modern applications with some clarity.	Identifies a few modern connections.
4.	Presentation Skills	8	Content is well-organized, visually appealing, and presented effectively.	Content is organized and presented clearly	Content is organized and presented clearly with minor shortcomings.
5.	Communication Skills	8	Ideas are communicated clearly, confidently, and engagingly with appropriate supporting evidence.	Ideas are communicated clearly with moderate confidence and adequate support.	Communication is understandable but lacks clarity, confidence, or supporting evidence.
	Total	40			

Rubrics for evaluation:CO6

Sl. No.	Criterion	Marks	Excellent (7-8)	Good(4-6)	Satisfactory (1-3)
1.	Application of Knowledge	8	Effectively applies Tamil scientific, technological, and cultural concepts to practical tasks and projects.	Applies concepts correctly with minor guidance.	Applies concepts at a basic level with limited effectiveness.
2.	Project Execution	8	Project is comprehensive, innovative, well-planned, and successfully completed.	Project is well-executed with minor shortcomings.	Project meets minimum requirements but lacks depth or completeness.
3.	Use of Evidence and Resources	8	Effectively uses relevant data, sources, and examples to support project outcomes.	Uses appropriate resources with adequate supporting evidence.	Uses limited resources and supporting evidence.
4.	Presentation Skills	8	Presents findings clearly, professionally, and effectively.	Presents findings clearly with minor shortcomings.	Presentation is adequate but lacks clarity, organization or professionalism.
5.	Documentation Quality	8	Documentation is comprehensive, accurate, well-organized and properly formatted.	Documentation is complete and organized with minor omissions.	Documentation is adequate but lacks detail, accuracy, or proper organization.
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24			24	3
C03	12	12			12	2
C04	12	12			12	2
C05			40		20	2
C06				40	20	2
Total	60	60	40	40	100	

Note:Purely as anExample: Strength = 3 (if percentage $\geq 20\%$);
Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage $<10\%$);

26MEC01	ENGINEERING GRAPHICS		SEMESTER				I	
Prerequisites			Category	ES(G)	Credits		4	
Basic geometry and Usage of drawing instrument			Hours/ Semester	L	T	P	SL	TH
				30	45	0	45	120
COURSE OBJECTIVES								
1.	To impart knowledge on dimensions and drawing standards.							
2.	To explore the projection of points, lines, planes and solids.							
3.	To explore the section of solids with various cutting planes							
4.	To provide the understanding of orthographic and isometric views.							
5.	To provide the understanding of perspective views and its applications.							
UNIT - I	PLANE CURVES, PROJECTION OF POINTS AND LINES							15
Fundamentals: Drawing instruments, Drawing standards (BIS), Lettering in engineering, Sheet layout, elements of dimensioning, Systems of dimensioning. Construction of curves - ellipse, parabola, and hyperbola (eccentricity method only), Construction of cycloids, involutes - Drawing of tangents and normal to the above curves. Projection of points and Lines – Projections points in all four quadrants, Projections of straight lines located in first quadrant – parallel and inclined to both planes - determination of true length and true inclinations by rotating line method.								
UNIT - II	PROJECTION OF PLANES AND PROJECTION OF SOLIDS							15
Projections of plane surfaces - polygonal lamina and circular lamina, located in the first quadrant and inclined to both reference planes. Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane.								
UNIT - III	SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES							15
Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane. Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.								
UNIT - IV	ORTHOGRAPHIC PROJECTION							15
Orthographic Projection: First angle projection, Visualization concepts - Representation of three-dimensional objects - layout of views - Different views of inclined, curved and simple objects.								
UNIT - V	ISOMETRIC AND PERSPECTIVE PROJECTION							15
Isometric projection , Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders, cones and simple objects. (For Exam) Perspective Projection: Simple solids - Prism and Pyramid by visual ray method.(For practice only)								
L:30, T:45 SL :45, Total:120 Hours								

Weightage: Continuous Assessment 40% End Semester Examinations 60%			
REFERENCE BOOKS:			
1.	Natarajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2005.		
2.	Warren J. Luzadder and Jon. M. Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., New Delhi, Eleventh Edition, 2005.		
3.	Gopalakrishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2001.		
4.	Basant Agrawal and CM Agrawal, Engineering Drawing, McGraw-Hill, New Delhi, First Edition, 2008.		
5.	Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2008.		
E-RESOURCES:			
1.	Online Resources (Open sources): nptel.ac.in/courses/112102304 https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr25_ed52		
2.	Engineering Drawing and Computer Graphics, Prof. Rajaram Lakkaraju (IIT Kharagpur) – https://onlinecourses.nptel.ac.in/noc22_me105/preview		
3.	MIT Design Handbook: Engineering Drawing and Sketching – https://ocw.mit.edu/courses/2-007-design-and-manufacturing-i-spring-2009/pages/related-resources/drawing_and_sketching/		
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Explain the fundamentals of engineering drawing, BIS standards, dimensioning methods, and standard drawing practices.	--	--
CO2	Construct engineering curves such as ellipse, parabola, hyperbola, cycloid, and involute, using standard drafting techniques.	PO1, PO2, PO3, PO5, PO10, PO11	PSO1, PSO2, PSO3
CO3	Apply the principles of projection to construct the projections of points, lines, planes, solids, sectional views, and surface developments.	PO1, PO2, PO3, PO5, PO10, PO11	PSO1, PSO2, PSO3
CO4	Apply projection principles to create orthographic, isometric, and perspective views of engineering objects using standard drawing practices.	PO1, PO2, PO3, PO5, PO10, PO11	PSO1, PSO2, PSO3
CO5	Construct engineering drawings of curves, projections, sectional views, and surface developments of simple solids using standard drafting instruments and BIS conventions.	PO1, PO2, PO3, PO5, PO10, PO11	PSO1, PSO2, PSO3
CO6	Create orthographic, isometric, and perspective drawings of engineering components and physical models to effectively communicate design and improve spatial visualization skills.	PO1, PO2, PO3, PO5, PO10, PO11	PSO1, PSO2, PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 01	PSO 02	PSO 03
CO1														
CO2	3	2	2		2					2	1	3	2	1
CO3	3	3	2		2					1	1	3	2	1
CO4	3	2	3		2					1	1	3	3	1
CO5	3	3	2		2					1	1	3	2	1
CO6	3	2	3		2					2	1	3	3	2

Activities:

1.	Construct conic sections, cycloids, involutes, and spirals using drawing instruments and demonstrate their formation using physical models or CAD tools.
2.	Mini Design Project – Create the complete drawing of a simple engineering component (e.g., bracket, machine block, pipe support) including orthographic, isometric, sectional view and dimensions.

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Accuracy of Engineering Curves	8	Curves are constructed accurately with correct dimensions and geometry	Minor errors in construction or dimensions	Noticeable errors affecting accuracy
2.	Projection and Sectional View Construction	10	Projections and sectional views are complete, correct, and clearly represented	Minor mistakes in views or missing details	Incomplete or incorrect representation
3.	Surface Development of Solids	8	Developments are accurate with correct geometry and layout	Minor dimensional or layout errors	Significant errors in development
4.	Use of Drawing Instruments and Standards	6	Proper use of instruments with BIS standards followed throughout	Small deviations from standards or instrument usage	Improper use of standards and instruments
5.	Neatness, Presentation, and Sheet Organization	8	Excellent line quality, lettering, dimensioning, and sheet layout	Acceptable presentation with few inconsistencies	Poor presentation and organization
	Total	40			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1	Accuracy of Orthographic Views	10	Produces complete and accurate orthographic views with correct dimensions and alignment	Produces views with minor dimensional or projection errors	Produces basic views with noticeable errors or incomplete details
2	Quality of Isometric Representation	10	Drawings are accurate, proportionate, and clearly represent the object	Drawings are mostly accurate with minor proportional issues	Drawings show limited accuracy and representation
3	Perspective Drawing Skills	8	Applies perspective principles correctly with realistic depth and proportions	Applies perspective concepts with minor errors	Demonstrates basic perspective drawing with several inaccuracy
4	Visualization and Interpretation Skills	8	Easily visualizes and converts objects into multiple graphical views accurately	Demonstrates good visualization with few interpretation mistakes	Shows limited visualization and interpretation ability
5.	Drawing Standards, Neatness, and Presentation	4	Excellent line quality, dimensioning, lettering, and neat presentation	Presentation is clear with minor issues in neatness or standards	Presentation is acceptable but lacks consistency and neatness
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	10	10			10	2
CO2	10				5	1
CO3	40	20			30	2
CO4		30			15	2
CO5			40		20	3
CO6				40	20	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26CSC01	C PROGRAMMING		SEMESTER				I
Prerequisites		Category	ES(G)	Credits			4
NIL		Hours/ Semester	L	T	P	SL	TH
			45	0	30	45	120
COURSE OBJECTIVES							
1.	To provide students with fundamental knowledge of C programming concepts, syntax, data types, operators, and control structures for developing computational solutions.						
2.	To develop logical thinking and problem-solving abilities through algorithm design, flowcharts, and structured programming techniques.						
3.	To enable students to design and implement modular programs using functions, arrays, pointers, strings, and user-defined data types in C.						
4.	To enhance students' debugging, testing, and program analysis skills for developing efficient and reliable software solutions.						
5.	To prepare students to apply C programming concepts in engineering applications, real-world problem solving, and further advanced computing courses.						
UNIT - I	C PROGRAMMING BASICS						9+6
Introduction to C programming- C program structure- Program Compilation and Execution- Language processing systems-Problem Solving Strategies-Algorithm-Flow Chart- Character Set- Identifiers& keywords- Data Types, Enumerations- Type conversions- Input & output statements in C – Operators- Preprocessor Directives (#include and #define): Macros. Practical Component: Develop simple C programs using basic programming constructs, input/ output operations and operators. Create algorithms, flowcharts and pseudocode for problem solving.							
UNIT - II	CONTROL STATEMENTS						9+6
Introduction to C programming- C program structure- Program Compilation and Execution- Language processing systems-Problem Solving Strategies-Algorithm-Flow Chart - Character Set- Identifiers& keywords- Data Types, Enumerations- Type conversions- Input & output statements in C – Operators- Preprocessor Directives (#include and #define): Macros. Practical Component: Develop simple C programs using basic programming constructs, input/ output operations and operators. Create algorithms, flowcharts and pseudocode for problem solving.							
UNIT - III	FUNCTIONS						9+6
Modular Programming- Function prototypes – Defining and Calling functions: Call by Value, Call by Address- Function call stack and Activation Records- Passing Arguments to Functions- Returning a value from a function- Recursion – Recursion Vs. Iteration- Scope and life time of variables- Memory layout of a C program- Storage Classes – Auto – Static – Extern and Register Variables. Practical Component: Implement programs using functions, parameter passing techniques, recursive functions, storage classes.							
UNIT - IV	ARRAYS, POINTERS AND STRINGS						9+6
Defining Array- Array Initialization- Accessing array elements- Processing Arrays- Multidimensional arrays- memory address calculation of an array- Row major and column major order- Pointers – Pointer Declaration- Operations on Pointer- Function pointer -Relation between pointers and arrays- String Handling Practical Component: Develop programs using arrays, strings and pointers.							

UNIT - V		STRUCTURES, UNION AND DATA FILES		9+6
Defining and processing a structure, Nested structures, passing structure to functions – Array of structure, Pointer to structure – Union – Dynamic memory allocation – Files: Streams, Opening and closing a file, Reading and writing a file. Practical Component: Develop programs using structures, unions and file handling operations.				
Total (45 L+ 30 P+ 45 SL) = 120 Hours				
Weightage: Continuous Assessment 50% End Semester Examinations 50%				
TEXT BOOK:				
1.	H.M. Deitel and P.J. Deitel, 'C: How to Program'. 9th edition, Pearson, New Delhi, 2022.			
2.	Herbert Schildt, 'C: The Complete Reference'. 4th edition, McGraw Hill, Noida, 2017.			
REFERENCE BOOKS:				
1.	Pradip Dey and Manas Ghosh, 'Programming in C'. Oxford University, New Delhi, 2018.			
2.	Mike McGrath, 'C Programming In Easy Steps Limited'. 5th edition, United Kingdom, 2018.			
3.	B.W. Kernighan and D.M. Ritchie, 'The C Programming Language', 2nd edition, Pearson, New Delhi, 2015.			
4.	Yashavant P. Kanetkar "Let Us C", BPB Publications., 2017, 16th edition			
E-RESOURCES:				
1.	"Introduction to C Programming", Swayam MOOC Course, - https://onlinecourses.swayam2.ac.in/imb25_mg71/			
2.	GeeksforGeeks - C Programming - https://www.geeksforgeeks.org/c-programminglanguage/			
3.	Learn - C.org - https://www.learn-c.org/			
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Explain the fundamentals and core concepts of C programming.		--	PSO1
CO2	Apply programming skills to develop C programs for the given problem statement/mathematical equation.		PO1	PSO1
CO3	Analyze the given C program and debug/predict its output.		PO2	PSO1
CO4	Develop and execute C programs to represent, compute, and solve mathematical equations or specified parameters.		PO3	PSO1
CO5	Make effective presentations on applications of C programming concepts as an individual.		PO6, PO9, PO11	PSO1
CO6	As a member of a team, identify and formulate programming problems, and develop, implement, and demonstrate appropriate solutions using suitable C programming concepts, techniques, and tools while abiding by ethics.		PO5, PO8, PO11	PSO1

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	2	-	-	3	-	2	2	-	-
CO6	-	-	-	-	3	-	-	3	-	-	2	2	-	-

Activities:

1.	Quiz /MCQ-Based Assessment (CO5)
2.	Hackathon / Coding Challenge Participation/ Team-Based Activities (CO6)

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Conceptual Understanding	25	Thorough understanding of concepts	Moderate understanding	Basic understanding
2.	Accuracy in Responses	25	Answers almost all correctly	Answers most correctly	Answers few correctly
3.	Logical Reasoning Ability	20	Strong analytical ability	Moderate reasoning ability	Limited reasoning ability
4.	Time Management	15	Completes within time confidently	Moderate reasoning ability	Unable to complete on time
5.	Participation and Preparedness	15	Highly active and well prepared	Moderately prepared	Limited participation
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Team Participation and Collaboration	25	Actively contributes and collaborates effectively with team members	Participates with moderate contribution	Limited participation in team activities
2.	Problem Solving Ability	25	Develops efficient and innovative solutions for the given problem	Develops acceptable solutions with minor issues	Unable to develop complete solutions
3.	Coding and Implementation Skills	20	Writes correct, efficient, and well-structured programs	Writes functional programs with few errors	Programs contain major errors/incomplete implementation

4.	Creativity and Innovation	15	Demonstrates creative thinking and innovative ideas	Shows moderate creativity	Limited creativity in approach
5.	Presentation and Demonstration	15	Clearly explains and demonstrates the solution confidently	Provides moderate explanation and demonstration	Unable to explain or demonstrate effectively
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Theory Component				Laboratory Component		Percentage Allocation	Mapping Strength
	Test I	Test II	Activity I	Activity II	Observation and Record	Test		
CO1	12	12	-	-	12	2	12	12
CO2	24	24	-	-	24	3	24	24
CO3	16	16	-	-	16	2	16	16
CO4	8	8	-	-	8	1	8	8
CO5	-	-	40		25	3	-	-
CO6	-	-	-	40	25	3	-	-
Total	60	60	40	40	100		60	60

Note: Strength = 3 (if percentage >20%); Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10)

26MAC02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORM TECHNIQUES B.E. (Common to CIVIL, ECE, MECH & METT)		SEMESTER			II	
Prerequisites		Category	BS	Credits			4
Basic knowledge of calculus, differential equations, complex numbers and elementary integration techniques.		Hours/ Semester	L	T	P	SL	TH
			45	15	-	60	120
COURSE OBJECTIVES							
1.	To understand the theory and solution methods of ordinary differential equations, including higher order equations, Euler–Cauchy equations, Legendre’s equations and systems of simultaneous differential equations.						
2.	To develop proficiency in Laplace transform techniques and their applications in solving initial value problems arising in science and engineering.						
3.	To acquire knowledge of Fourier series representations, harmonic analysis and Parseval’s identity for analyzing periodic functions.						
4.	To understand Fourier, transform methods, their properties and applications in solving problems related to signal analysis and integral transforms.						
5.	To learn the concepts of Z-transforms and difference equations and apply transform techniques for solving discrete mathematical and engineering models.						
UNIT - I		ORDINARY DIFFERENTIAL EQUATIONS					9+3
Homogeneous linear ordinary differential equations of second order -general solution- Particular Integral- Solution by variation of parameters-Homogeneous equations of Euler–Cauchy and Legendre’s type – System of simultaneous linear differential equations with constant coefficients.							
UNIT - II		LAPLACE TRANSFORMS					9+3
Existence theorem - Transform of standard functions – Transform of Unit step function and Dirac delta function – Basic properties - Shifting theorems - Transforms of derivatives and integrals – Transform of periodic functions - Initial and Final value theorem - Inverse Laplace transforms- Convolution theorem (without proof) – Solving Initial value problems by using Laplace Transform techniques.							
UNIT - III		FOURIER SERIES					9+3
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Parseval’s identity – Computation of harmonics.							
UNIT - IV		FOURIER TRANSFORMS					9+3
Fourier integral theorem – Fourier transform pair - Fourier sine and cosine transform – Properties – Transform of elementary functions – Inverse Fourier Transforms - Convolution theorem (without proof) – Parseval’s identity.							
UNIT - V		Z – TRANSFORM AND DIFFERENCE EQUATIONS					9+3
Z-transform – Properties of Z-transform – Inverse Z-transform – Convolution theorem – Evaluation of Inverse Z transform using partial fraction method and convolution theorem - Initial and final value theorems – Formation of difference equations – Solution of difference equations using Z - transform.							
L:45, T:15, SL :60, Total:120 Hours							
Weightage:							
Continuous Assessment: 40%							
End Semester Examinations: 60%							

TEXT BOOKS:				
1.	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 45 th Edition, New Delhi, 2020.			
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10 th Edition, Wiley India Pvt Ltd., New Delhi, 2018.			
REFERENCE BOOKS:				
1.	N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008			
2.	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5 th Edition, New Delhi, 2017.			
3.	Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi, 2012.			
E-RESOURCES:				
1.	NPTEL, "Differential Equations", National Programme on Technology Enhanced Learning, https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ma115			
2.	NPTEL, "Transforms and Their Applications", National Programme on Technology Enhanced Learning, https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ma56			
3.	MIT OpenCourseWare, "Differential Equations", Massachusetts Institute of Technology, https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/			
4.	Paul's Online Math Notes, "Differential Equations", Lamar University, https://tutorial.math.lamar.edu/classes/de/de.aspx			
5.	Wolfram MathWorld, "Fourier Series, Fourier Transform, Laplace Transform and Z-Transform", Wolfram Research, https://mathworld.wolfram.com/LaplaceTransform.html			
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Remember and understand the fundamental concepts and methods of ordinary differential equations, Laplace transforms, Fourier series, Fourier transforms, and Z-transforms including solutions of differential equations, transform techniques, Fourier expansions, transform properties, convolution theorems and difference equations used in mathematical and engineering applications.		--	--
CO2	Apply the techniques of ordinary differential equations, Laplace transforms, Fourier series, Fourier transforms and Z-transforms to solve mathematical and engineering problems involving initial value problems, periodic functions, signal analysis, transform methods and difference equations.		PO1	PSO1
CO3	Analyze mathematical and engineering problems using ordinary differential equations, Laplace transforms, Fourier series, Fourier transforms, and Z-transforms by selecting appropriate analytical methods, interpreting transform-domain representations, examining periodic behaviours and solving continuous and discrete system models.		PO2	PSO1
CO4	Investigate and interpret mathematical models through assignments, case-based problems and transform techniques to develop logical reasoning and problem-solving skills for engineering applications.		PO3	PSO2

CO5	Solve assignment-based analytical problems involving differential equations, Laplace transforms, Fourier series, Fourier transforms and Z-transforms by applying systematic mathematical procedures and computational techniques.	PO5	PSO2
CO6	Communicate mathematical concepts, transform techniques, solution procedures and results effectively through proper mathematical notation, graphical representation, computational output, assignments and structured report writing for engineering and applied science problems.	PO10	--

The Course Articulation Matrix (CAM) for defined COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3											3		
CO3		2										2		
CO4			1										1	
CO5					3								1	
CO6										3				
Avg	3	2	1		3					3		2.5	1	

Activities:

1.	Students shall solve selected problems from ordinary differential equations, Laplace transforms, Fourier series, Fourier transforms, Z-transforms and difference equations using systematic analytical methods and suitable computational tools such as Python, GeoGebra or open-source software. This activity develops the ability to apply transform techniques and computational methods to solve engineering and applied science problems with accuracy and logical reasoning.
2.	Students shall prepare a structured assignment report or presentation on selected application-oriented problems involving ordinary differential equations, Laplace transforms, Fourier series, Fourier transforms, Z-transforms and difference equations. The activity may include problem formulation, step-by-step solution, graphical representation, computational output, interpretation of results, and conclusion. This activity develops the ability to communicate mathematical concepts, transform techniques, solution procedures and results effectively using proper notation, graphs and organized report writing.

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (7-8)	Good (4-6)	Satisfactory (1-3)
1.	Selection and understanding of problem	8	Suitable analytical problem is selected and the concept is clearly understood	Problem is selected properly, but conceptual explanation needs minor improvement	Problem selection is basic and conceptual understanding is limited
2.	Application of mathematical method	8	Correct method is applied with clear step-by-step solution	Method is mostly correct with minor errors	Method is unclear or contains major errors

3.	Use of analytical/computational technique	8	Analytical or computational technique is used effectively and results are accurate	Technique is used properly, but minor computational/procedural errors are present	Technique usage is incomplete or not clearly demonstrated
4.	Accuracy and interpretation of results	8	Results are accurate and clearly interpreted with engineering/application relevance	Results are mostly correct, but interpretation needs improvement	Results are inaccurate or interpretation is weak
5.	Presentation and professional communication	8	Work is professionally presented with clear mathematical communication	Presentation is good with minor organizational issues	Presentation is satisfactory but lacks consistency
	Total	40			

Rubrics for evaluation:CO6

Sl. No.	Criterion	Marks	Excellent (7-8)	Good (4-6)	Satisfactory (1-3)
1.	Clarity of mathematical explanation	8	Concepts, formulae and solution procedures are explained clearly and correctly	Explanation is understandable, but needs minor improvement	Explanation is incomplete or unclear
2.	Use of mathematical notation, graphs and representation	8	Proper notation, equations, graphs, tables or computational outputs are used effectively	Notation and representation are mostly correct with minor errors	Notation is poor or graphical/computational representation is missing
3.	Organization of assignment/report/presentation	8	Report/presentation is well structured with problem statement, method, solution, result, interpretation and conclusion	Report/presentation is organized, but some sections need improvement	Report/presentation is poorly organized or incomplete
4.	Interpretation and communication of results	8	Results are interpreted clearly and communicated effectively with logical conclusion	Results are communicated properly, but interpretation is limited	Interpretation and communication of results are weak
5.	Overall presentation and academic quality	8	Work demonstrates excellent academic quality and professional presentation	Academic quality is good with minor issues	Academic presentation is satisfactory
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24	-	-	24	3
C03	16	16	-	-	16	2
C04	8	8	-	-	8	1
C05	-	-	40	-	25	3
C06	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26ENC02	PROFESSIONAL ENGLISH B.E. (Common to all Branches)		SEMESTER				II
Prerequisites		Category	HM	Credits			2
Basic language skills listening, speaking, reading and writing		Hours/ Semester	L	T	P	SL	TH
			30	-	15	15	60
COURSE OBJECTIVES							
1.	To develop learners' overall communication competence through integrated listening, reading, speaking, and writing activities.						
2.	To enhance learners' reading fluency and comprehension with appropriate pronunciation, intonation, and expression across different text types.						
3.	To build learners' oral communication skills for narration, speeches, presentations, and professional interactions.						
4.	To equip learners with organizational and presentation skills required for academic, technical, and event-based communication.						
5.	To enable learners to describe processes, ideas, and technical activities clearly and confidently in real-life contexts.						
UNIT - I		FUNDAMENTALS OF COMMUNICATION					9
Listening: Interview with personal assistant, An interview with a business consultant, Describing changes in a company. Reading: Reading a short story – learning pronunciation, intonation, splitting of sentences to form meaningful units. Speaking: Self-introduction, name, home background, study details, area of interest, hobbies, strengths and weaknesses, etc. Writing: Communication and its types - Technical Communication, Review of a favourite movie or a book. Grammar: Tenses – Present tense, Past tense, Future tense. Voices – Active voice, Passive voice.							
UNIT - II		PRESENTATION SKILLS					9
Listening: An interview about a production process, Telephone conversations, Making and changing appointments. Reading: Reading a poem – learning the skill of reciting, appreciate rhyme and music, change in tone etc. Speaking: Power point presentation on a general topic. Writing: Essay writing – Descriptive and narrative essays, Precise writing. Grammar: Common errors in English – Subject Verb agreement, Articles.							
UNIT - III		PUBLIC SPEAKING					9
Listening: Conversation between two employees, Interview about change in job and corporate gift giving. Reading: Reading newspaper article – learning vocabulary and language pattern of official communication. Speaking: Oral presentation on a topic from basic engineering related to their branch. Writing: Writing a news article, Minutes of meetings. Grammar: Prefix and suffix, Phrasal verbs, Degrees of comparison.							
UNIT - IV		ORGANIZING EVENTS					9
Listening: Working in an international team, Statistical information, Interview with investor relations. Reading: Company profiles, Statement of Purpose (SOP), An excerpt of interview with professionals. Speaking: Proposing welcome address, vote of thanks and organizing events. Writing: Letter Writing – Formal Letters and Informal Letters, Job Application, Cover letter with resume. Grammar: Reported speech, Question tags, Simple, Compound and Complex sentences.							

UNIT - V	PROCESS DESCRIPTION	9	
Listening: An interview with recruitment agent, Meeting extracts, Description of how a product is advertised. Reading: Reading advertisements, gadget reviews, user manuals. Speaking: Describing a process – taking print outs, purchasing equipment for a company, booking a hall for meeting etc. Writing: Process description, Designing advertisements. Grammar: Cloze test, Homophones, Cause and effect expressions.			
L:30, P:15, SL :15, Total:60 Hours			
Weightage: Continuous Assessment - 50% End Semester Examinations - 50%			
REFERENCE BOOKS:			
1.	Beare, Kenneth. <i>Reading Skills Success in 20 Minutes a Day</i> . 4th ed., LearningExpress, 2017.		
2.	Hewings, Martin. <i>Advanced English Grammar</i> . 3rd ed., Cambridge University Press, 2019.		
3.	Koneru, Aruna. <i>English Language Skills for Engineers</i> . McGraw Hill Education, 2020.		
4.	Murphy, Raymond. <i>English Grammar in Use</i> . 5th ed., Cambridge University Press, 2019.		
5.	Guffey, Mary Ellen, and Dana Loewy. <i>Essentials of Business Communication</i> . 12th ed., Cengage Learning, 2021		
E-RESOURCES:			
1.	https://learnenglish.britishcouncil.org/		
2.	https://www.futurelearn.com/		
3.	https://www.ted.com/		
4.	https://www.cambridgeenglish.org/		
5.	https://www.coursera.org/		
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Demonstrate effective listening, reading, speaking, and writing (LSRW) skills in academic and professional communication contexts.	PO9, PO11	
CO2	Apply appropriate grammar, vocabulary, pronunciation, and language conventions to ensure accurate, fluent, and effective communication across various contexts.	PO9, PO11	
CO3	Deliver oral presentations, speeches, and self-introductions confidently using suitable verbal and non-verbal communication strategies.	PO9, PO11	PSO1
CO4	Analyze and interpret different forms of written texts such as stories, poems, newspaper articles, company profiles, advertisements, and technical documents.	PO9, PO11	PSO2
CO5	Develop professional writing skills for drafting reviews, essays, news articles, minutes of meetings, letters, resumes, cover letters, process descriptions, and advertisements.	PO9, PO10	PSO3

[illegible]

	(iv)Public Speaking and Group Discussion Activity: Engage in extempore speeches, group discussions, debates, and seminar presentations on engineering, social, or professional topics to improve confidence and interpersonal communication. (v) Professional Interaction and Team Collaboration Project: Work collaboratively in teams to conduct meetings, coordinate event-related tasks, prepare communication plans, and demonstrate leadership, teamwork, and professional etiquette in achieving common objectives.
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Rubrics for evaluation:CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Content Relevance and Completeness	10	Content is highly relevant, complete, and fully meets task requirements	Mostly relevant and complete with minor omissions	Adequate content but lacks depth or some key points missing
2.	Organization and Format	10	Excellent adherence to format	Proper format with minor structural issues	Basic structure present but inconsistent formatting
3.	Clarity and Coherence	10	Ideas are very clear, logically sequenced, and easy to follow	Generally clear with minor lapses in flow	Understandable but lacks smooth transitions
4.	Language Use	10	Excellent grammar, precise vocabulary, no errors	Minor grammatical / spelling errors	Noticeable errors but meaning is clear
	Total	40			

Rubrics for evaluation:CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Presentation Skills	10	Highly confident, clear articulation, excellent eye contact, and engaging delivery	Clear and confident with minor issues in delivery	Adequate presentation with some hesitation
2.	Communication Effectiveness	10	Excellent verbal & non-verbal communication; ideas conveyed clearly and persuasively	Good communication with minor gaps	Understandable communication but lacks impact
3.	Interpersonal Skills and Teamwork	10	Excellent collaboration, leadership, and positive interaction with team members	Good teamwork and cooperative behavior	Works with team but limited engagement
4.	Event/Activity Organization Skills	10	Excellent planning, coordination, and execution of tasks/events	Good organization with minor gaps in execution	Basic organization with limited efficiency
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Theory Component				Laboratory Component		Percentage allocation	Mapping Strength
	Test I	Test II	Activity I	Activity II	Observation and Record	Test		
CO1	12	12			10	10	11	2
CO2	24	24			20	20	22	3
CO3	12	12			30	30	21	3
CO4	12	12			20	20	16	2
CO5			40		10	10	15	2
CO6				40	10	10	15	2
Total	60	60	40	40	100	100	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26PHC02	MATERIALS SCIENCE		SEMESTER				II
Prerequisites		Category	BS	Credits			3
		Hours/ Semester	L	T	P	SL	TH
			45	-	-	45	90
COURSE OBJECTIVES							
1.	To understand the fundamental concepts of semiconductor materials, carrier transport mechanisms, and their applications.						
2.	To explain the polarization mechanisms, dielectric behaviour and practical applications of dielectric materials in electrical and electronic systems.						
3.	To analyse the properties and applications of magnetic materials and superconductors used in modern engineering technologies.						
4.	To gain knowledge of nanomaterials, their synthesis techniques, characterization methods, properties and multidisciplinary applications.						
5.	To understand advanced engineering materials such as metallic glasses, shape memory alloys, ceramics, composites and their applications.						
UNIT - I		SEMICONDUCTING MATERIALS					9
Semiconductor materials: Intrinsic and extrinsic semiconductors - Carrier concentration(derivation) for intrinsic semiconductor, n-type and p-type semiconductor – Fermi level – Variation of carrier concentration on temperature and impurity – Direct and indirect bandgap semiconductor – Drift and diffusion currents – Hall effect – Determination of Hall coefficient – Applications – Metal–semiconductor junctions (Ohmic and Schottky junctions).							
Activity: Virtual demonstration of Hall effect							
UNIT - II		DIELECTRIC MATERIALS					9
Dielectric materials: Dielectric polarization – Electronic, ionic, orientational and space charge polarization – Internal fields in solids – Clausius–Mossotti relation – Frequency dependence of polarization - Application of dielectric materials (transformers and capacitors), Dielectric loss – Dielectric breakdown - Ferro and piezo electric materials.							
Activity: Virtual demonstration of ferro electric materials							
UNIT - III		MAGNETIC AND SUPERCONDUCTING MATERIALS					9
Magnetic Materials: Magnetic material parameters, Ferromagnetic materials – Hysteresis - Ferrites – Soft and Hard magnetic materials, GMR sensors, magnetic disk memories, Principle of magnetic recording, Materials for magnetic data storage.							
Superconductivity: Properties – Type I & Type II superconductors – BCS theory – Applications – magnetic levitation – SQUID.							
Activity: Virtual demonstration of MAGLEV trains							
UNIT - IV		NANOMATERIALS					9
Nanomaterials: Introduction – Classification of nanomaterials – Top-down and bottom-up approaches – Synthesis techniques: Ball milling, Plasma arcing, Sol-Gel method – Quantum confinement effect – Quantum structures: Quantum wells, Quantum wires and Quantum dots –Band gap of nanomaterials. Carbon nanotubes – Graphene, Fullerene and Buckyballs – Structure – Properties – Applications. Nanodevices: Quantum dot LEDs (QLEDs), Nanosensors and Nano-transistors							
Activity: Virtual demonstration of QLED							

UNIT - V		ADVANCED ENGINEERING MATERIALS		9
Metallic Glasses: Preparation – Properties – Applications. Shape Memory Alloys (SMA): Types – Properties – Applications. Ceramic Materials: Classification – Properties – Traditional and advanced ceramics – Applications. Composite Materials: Classification – Fibre reinforced composites – Particle reinforced composites – Properties – Applications.				
Activity: Virtual demonstration of melt-spinning process				
L:45, SL :45, Total:90 Hours				
Weightage: Continuous Assessment 40% End Semester Examinations 60%				
TEXT BOOKS:				
1.	M. Arumugam, 'Materials Science', Anuradha Publications, Kumbakonam, 2018.			
2.	V. Rajendran and A. Marikani, 'Materials Science', Tata McGraw Publications, New Delhi, 2012.			
3.	S.O. Pillai, 'Solid State Physics', New Age International Publishers, New Delhi, 2026.			
REFERENCE BOOKS:				
1.	Charles Kittel, 'Introduction to Solid state Physics', John Wiley and Sons, 7 th Edition, Singapore, 2019.			
2.	Charles P. Poole and Frank J. Owens, 'Introduction to Nanotechnology', Wiley India, 2007.			
3.	S. O. Kasap, 'Principles of electronic materials and devices', McGrawHill Education, 2007.			
E-RESOURCES:				
1.	Hall Effect: https://ssp-amrt.vlabs.ac.in/exp/hall-effect-chargecarrier/simulation.html			
2.	Hysteresis curve: https://em-amrt.vlabs.ac.in/exp/quinckes-method			
3.	Magnets and Electromagnets: https://phet.colorado.edu/en/simulations/magnets-and-electromagnets			
COURSE OUTCOMES (COs) At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Explain the preparation, properties and applications of various materials.		--	
CO2	Apply the principles of various materials to identify suitable materials for diverse applications.		PO1	
CO3	Analyse the properties and performance of different materials suitable for specific applications.		PO2	
CO4	Perform experimentations as a group and interpret the results.		PO4, PO8	
CO5	Communicate the societal, environmental and technological impacts of engineering materials in solving real-world problems.		PO6, PO9	PSO3
CO6	Analyse emerging engineering materials to address modern industrial and societal needs in engineering applications through self-learning activities.		PO11	

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3													
CO3		3												
CO4				2				2						
CO5						2			2					2
CO6											2			

Activities:

1.	a. Experimental determination of Hall coefficient / Hysteresis loop for a ferromagnetic material (CO4) b. Seminar / Poster presentation on dielectric materials in renewable energy systems / Economic, Environmental and Social issues of material usage (CO5)
2.	a. Literature review on nanomaterial product for real-world problems (CO6) b. Seminar/Poster presentation on emerging concepts and advancements in materials science, considering the economic, environmental, and societal impacts of material usage. (CO5)

Rubrics for evaluation (CO4)

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Formula / Theory	5	Clearly explains the concept with correct formula	Explains the concept with minor errors	Limited understanding of theory and formula
2.	Procedure & Observation	5	Clearly performs and explains the experimental procedure with accurate observations	Performs the procedure with minor mistakes	Procedure and observations are poorly explained
3.	Result & Interpretation	10	Correctly calculates and correlates the result with theoretical concepts	Result is obtained with partial interpretation	Incorrect or incomplete result interpretation
	Total	20			

Rubrics for evaluation (CO5)

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Subject Knowledge	5	Clearly explains the concept with relevant examples	Good explanation with minor gaps	Basic understanding of the topic
2.	Content Organization	5	Information is well-organized, clear, and logically presented	Organization is good with minor improvements needed	Average organization of content

3.	Poster / Presentation Design	5	Attractive, creative, and easy-to-understand design with effective visuals	Good design with minor issues	Adequate design with limited visuals
4.	Communication Skills	5	Confident presentation with clear explanation and effective response to questions	Good communication with slight hesitation	Basic communication skills
	Total	20			

Rubrics for evaluation (CO6)

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Topic Understanding	5	Clearly explains the concept and its real-world application with relevant details	Good explanation with minor gaps	Basic understanding of the topic
2.	Literature Review	5	Reviews and compares multiple relevant research articles effectively	Reviews relevant articles with some comparison	Limited review of articles
3.	Analysis & Interpretation	5	Critically analyses the product performance, advantages, and limitations	Good analysis with minor shortcomings	Basic analysis provided
4.	Presentation & Communication	5	Well-organized report/presentation with clear communication and proper references	Organized presentation with minor errors	Average presentation and communication
	Total	20			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	12	12			12	2
CO2	24	24			24	3
CO3	24	24			24	3
CO4			20		10	2
CO5			20	20	20	2
CO6				20	10	2
Total	60	60	40	40	100	

Note: Strength = 3 (if percentage >20%); Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26HMC02	தமிழரும் தொழில்நுட்பமும் B.E. (அனைத்து துறைகளுக்கும் பொதுவானது)		பருவம்			II	
முன்தேவைகள்:		Credits	HM	Credits		1	
தமிழ் மொழி மற்றும் இலக்கியத்தின் அடிப்படைகள்		Hours/ Semester	L	T	P	SL	TH
			15	-	-	15	30
பாடநோக்கங்கள்							
1.	நெசவுத் தொழில்நுட்பம் மற்றும் மட்பாண்டத் தொழில்நுட்பம் குறித்த அறிவைப் பெறுதல்.						
2.	சங்ககாலம் மற்றும் ஆங்கிலேயர் ஆட்சிக் கால கட்டிட வடிவமைப்பு மற்றும் கட்டுமானத் தொழில்நுட்பங்களை அறிதல்.						
3.	உற்பத்தித் தொழில்நுட்பங்களைப் பற்றிய புரிதலை வளர்த்தல்.						
4.	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்ப அறிவைப் பெறுதல்.						
5.	அறிவியல் தமிழ் மற்றும் தமிழ் கணினியியல் வளர்ச்சியை அறிதல்.						
அலகு- I		நெசவு மற்றும் பாணை தொழில்நுட்பம்					3
சங்க காலத்தில் நெசவுத் தொழில் - பாணை தொழில் நுட்பம் - கருப்பு சிவப்பு பாண் டங்கள் - பாண் டங்களில் கீறல் குறியீடுகள்.							
அலகு- II		வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்					3
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும் , கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபொட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ சாரோசெனிக் கட்டிடக் கலை.							
அலகு- III		உற்பத்தித் தொழில் நுட்பம்:					3
கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலொற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண் டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.							
அலகு- IV		வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்					3
வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் அணைகள், ஏரிகள், குளங்கள் மற்றும் மதகு அமைப்புகள் சோழர் கால குமிழித் தூம்பின் முக்கியத்துவம் கால்நடை வளர்ப்பு மற்றும் கால்நடைகளுக்கான கிணறு வடிவமைப்புகள் வேளாண்மை மற்றும் வேளாண் செயலாக்கம் கடல் மற்றும் பெருங்கடல் அறிவு மீன்பிடித்தல், முத்துக்குளித்தல் மற்றும் சங்கு மூழ்குதல் அறிவு சார்ந்த சமூக அமைப்பு அறிவியல் தமிழின் வளர்ச்சி தமிழ் கணினியியல் தமிழ்							

நூல்களின் மின்னாக்கம் தமிழ் மென்பொருள் வளர்ச்சி தமிழ் இணையக் கல்விக்கழகம் தமிழ் மின்னணு நூலகம் இணையத் தமிழ் அகராதிகள் சொற்குவைத் திட்டம்			
அலகு- V		அறிவியல் தமிழ் மற்றும் கணித்தமிழ்:	
		3	
அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி- தமிழ் நூல்களை மின் பதிப்பு செய்தல் – தமிழ் மென் பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.			
L:15, SL :15, Total:30 Hours			
மதிப்பீட்டு பங்கு: தொடர் மதிப்பீடு: 40% பருவ இறுதித் தேர்வுகள்: 60%			
குறிப்பு நூல்கள்:			
1.	பி. டி. சீனிவாச அய்யங்கார், தமிழர்களின் வரலாறு (History of the Tamils), கியான் பப்ளிஷிங் ஹவுஸ், 2020.		
2.	கே. ஏ. நீலகண்ட சாஸ்திரி, சங்க இலக்கியம்: அதன் சமயங்களும் பண்பாடுகளும் (Sangam Literature: Its Cults and Cultures), ஸ்வாதி பப்ளிகேஷன்ஸ், 2006.		
3.	சித்ரா மாதவன், தமிழ்நாட்டின் வரலாறும் பண்பாடும் (History and Culture of Tamil Nadu), டி.கே. பிரிண்ட் வேர்ல்ட், 2005.		
4.	ஆர். பொன்னுசாமி, தமிழ் கணினியியல் (Tamil Computing), அலைட் பப்ளிஷர்ஸ் பிரைவேட் லிமிடெட், 2025.		
5	எஸ். முத்திராமலிங்கம் & மு. சரவணகுமார், தமிழர்களும் தொழில்நுட்பமும் (Tamils and Technology), விஜய் நிக்கோல் இம்பிரிண்ட்ஸ் பிரைவேட் லிமிடெட், 2024		
மின்னணுவளங்கள்:			
1.	https://atlanticbooks.com/products/history-of-the-tamils-from-the-earliest-times-to-600-a-d-9788121235518		
2.	https://books.google.co.in/books/about/Sangam_Literature_Its_Cults_and_Cultures.html?id=j1ZsnQEACAAJ&redir_esc=y		
3.	https://books.google.co.in/books/about/History_and_Culture_of_Tamil_Nadu		
4.	https://www.booksamillion.com/p/Tamil-Computing/R-Ponnusamy/9789390951055		
5.	https://www.amazon.in/Tamils-Technology-English-S-Muthuramalingam/dp/8119243307		
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to			
CO1	நெசவு மற்றும் மட்பாண்டத் தொழில்நுட்பம் பற்றிய அறிவைப் பெறுவர்.	PO9	-
CO2	சங்ககாலம் மற்றும் ஆங்கிலேயர் கால கட்டிட வடிவமைப்பு மற்றும் கட்டுமானத் தொழில்நுட்பங்களை அறிந்திருப்பர்.	PO9	-
CO3	உற்பத்தித் தொழில்நுட்பங்களைப் புரிந்துகொள்வர்.	PO9	PSO1

CO4	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பத் திறன்களைப் பெறுவர்.	PO9	-
CO5	அறிவியல் தமிழ் மற்றும் தமிழ் கணினியியல் வளர்ச்சி குறித்த அறிவைப் பெறுவர்.	PO9, PO11	PSO3
CO6	களப்பணி மற்றும் மின்னணு கற்றல் நடவடிக்கைகள் மூலம் தமிழ் பாரம்பரியத்தைப் புரிந்துகொள்வர்.	PO9, PO11	PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1									3					
CO2									3					
CO3									3			2		
CO4									3					
CO5									3		2			2
CO6									3		2			2

செயல்பாடுகள்:

1.	CO5: - அறிவியல் தமிழின் வளர்ச்சி வரலாற்றை விளக்கும் அறிக்கை தயாரித்தல். - தமிழ் மென்பொருட்கள், எழுத்துருக்கள் மற்றும் மின்னணு தளங்கள் குறித்த PowerPoint வழங்கல் தயாரித்தல். - இணையத் தமிழ் அகராதி, தமிழ் இணையக் கல்விக்கழகம் மற்றும் தமிழ் மின்னணு நூலகப் பயன்பாட்டை விளக்குதல். - Unicode கருவிகளைப் பயன்படுத்தி தமிழ் தட்டச்சு மற்றும் வடிவமைப்பு செயல்முறை பயிற்சி. - நவீன அறிவியல் மற்றும் தொழில்நுட்பத் தகவல் பரிமாற்றத்தில் தமிழின் பங்கு குறித்த குழு விவாதம்.
2.	CO6: - பாரம்பரியத் தளங்கள் / அருங்காட்சியகங்கள் / கோயில்களுக்கு களப்பயணம் செய்து புகைப்படங்களுடன் அறிக்கை சமர்ப்பித்தல். - உள்ளூர் கலாச்சாரப் பாரம்பரியம் குறித்த ஆவணத் திட்டம் தயாரித்தல். - தமிழ் தொழில்நுட்ப சாதனைகள் குறித்த போஸ்டர் அல்லது விளக்கப்படம் உருவாக்குதல். - சங்ககால அறிவியல் மற்றும் தொழில்நுட்ப நடைமுறைகள் குறித்த கருத்தரங்கு நடத்துதல். - தமிழ் பாரம்பரிய அம்சங்களை வெளிப்படுத்தும் மின்னணு ஸ்கிராப் புத்தகம் அல்லது e-Portfolio உருவாக்குதல், பண்டைய தமிழ் தொழில்நுட்பம் அல்லது அறிவு அமைப்புகளில் ஏதேனும் ஒன்றை அடிப்படையாகக் கொண்ட வழக்குக்கூற்று வழங்குதல்.

CO5 மதிப்பீட்டு அளவுகோல்கள்:

வரி சை எண்	அளவுகோல்	மதிப் பெண் கள்	சிறப்பு (7-8)	நல்லது (4-6)	திருப்திகரமானது (1-3)
1.	தமிழ் பாரம்பரிய அறிவு	8	தமிழ் அறிவியல், தொழில்நுட்ப மற்றும் பண்பாட்டு பாரம்பரியத்தை முழுமையாகவும் துல்லியமாகவும் விளக்குகிறது.	நல்ல புரிதலை வெளிப்படுத்துகி றது, சில சிறிய விடுபாடுகள் இருக்கலாம்.	அடிப்படை அறிவை மட்டுமே காட்டுகிறது; விவரங்கள் குறைவாக உள்ளன.
2.	வரலாற்றுப் புரிதல்	8	வரலாற்றுப் பின்னணி மற்றும் அதன் முக்கியத்துவத்தை பொருத்தமான எடுத்துக்காட்டுகளு டன் தெளிவாக விளக்குகிறது.	வரலாற்றுப் பின்னணியை சில எடுத்துக்காட்டுக ளுடன் விளக்குகிறது.	வரலாற்றுப் பின்னணி குறித்த விளக்கம் மிகவும் வரையறுக்கப்பட்டு ள்ளது.
3.	தற்காலப் பொருத்தம்	8	பாரம்பரிய அறிவையும் சாதனைகளையும் தற்போதைய பயன்பாடுகளுடன் திறம்பட இணைக்கிறது.	பாரம்பரிய அறிவை நவீன பயன்பாடுகளுட ன் ஓரளவு தெளிவாக தொடர்புபடுத்துகி றது.	சில நவீன தொடர்புகளை மட்டுமே அடையாளம் காட்டுகிறது.
4.	வழங்கல் திறன்	8	உள்ளடக்கம் சிறப்பாக ஒழுங்குபடுத்தப்பட்டு, காட்சிப்பூர்வமாக கவர்ச்சிகரமாகவும் பயனுள்ளதாகவும் வழங்கப்படுகிறது.	உள்ளடக்கம் நன்கு ஒழுங்குபடுத்தப் பட்டு, சில குறைகளுடன் வழங்கப்படுகிற து.	வழங்கல் அடிப்படை நிலையில் உள்ளது; தெளிவு மற்றும் ஒழுங்கமைப்பு குறைவாக உள்ளது.
5.	தொடர்புத் திறன்	8	கருத்துக்கள் தெளிவாகவும் நம்பிக்கையுடனும் ஆதாரங்களுடன் விளக்கப்படுகின்ற ன.	கருத்துக்கள் போதுமான ஆதாரங்களுடன் தெளிவாக வெளிப்படுத்தப்ப டுகின்றன.	கருத்துக்கள் புரியும் வகையில் இருந்தாலும் தெளிவு, நம்பிக்கை அல்லது ஆதாரங்கள் குறைவாக உள்ளன.
	மொத்தம்	40			

CO6 மதிப்பீட்டு அளவுகோல்கள்:

வரி சை எண்	அளவுகோல்	மதிப் பெண் கள்	சிறப்பு (7-8)	நல்லது (4-6)	திருப்திகரமானது (1-3)
1.	அறிவின் பயன்பாடு	8	தமிழ் அறிவியல், தொழில்நுட்ப மற்றும் பண்பாட்டு கருத்துக்களை செயல்முறைப் பணிகளில் திறம்படப் பயன்படுத்துகிறது.	கருத்துக்களை சரியாகப் பயன்படுத்துகிறது; குறைந்த வழிகாட்டுதல் தேவைப்படுகிறது.	அடிப்படை அளவில் மட்டுமே கருத்துக்களைப் பயன்படுத்துகிறது.
2.	திட்ட செயல்படுத்த ல்	8	திட்டம் முழுமையானதாகவும் புதுமையானதாகவும் நன்கு திட்டமிடப்பட்டு வெற்றிகரமாக நிறைவேற்றப்பட்டுள் ளது.	திட்டம் நன்றாக செயல்படுத்தப்பட் டுள்ளது; சில சிறிய குறைகள் உள்ளன.	குறைந்தபட்ச தேவைகளை பூர்த்தி செய்கிறது; ஆனால் ஆழம் மற்றும் முழுமை குறைவாக உள்ளது.
3.	ஆதாரங்கள் மற்றும் வளங்களின் பயன்பாடு	8	பொருத்தமான தரவுகள், ஆதாரங்கள் மற்றும் எடுத்துக்காட்டுகளை திறம்படப் பயன்படுத்துகிறது.	பொருத்தமான வளங்களைப் பயன்படுத்தி போதுமான ஆதாரங்களை வழங்குகிறது.	குறைந்த அளவிலான வளங்கள் மற்றும் ஆதாரங்களை மட்டுமே பயன்படுத்துகிறது.
4.	வழங்கல் திறன்	8	கண்டறிவுகளை தெளிவாகவும் தொழில்முறையாகவு ம் திறம்படவும் வழங்குகிறது.	கண்டறிவுகள் தெளிவாக வழங்கப்படுகின்ற ன; சில சிறிய குறைகள் உள்ளன.	வழங்கல் போதுமானதாக இருந்தாலும் தெளிவு, ஒழுங்கமைப்பு அல்லது தொழில்முறைத் தன்மை குறைவாக உள்ளது.
5.	ஆவணப்படுத் தல் தரம்	8	ஆவணங்கள் முழுமையாகவும் துல்லியமாகவும் ஒழுங்குபடுத்தப்பட்டு ம் சரியான வடிவமைப்புடனும் உள்ளன.	ஆவணங்கள் முழுமையாகவும் ஒழுங்காகவும் உள்ளன; சில சிறிய விடுபாடுகள் இருக்கலாம்.	ஆவணங்கள் போதுமானதாக இருந்தாலும் விவரம், துல்லியம் அல்லது ஒழுங்கமைப்பு குறைவாக உள்ளது.
	மொத்தம்	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24			24	3
C03	12	12			12	2
C04	12	12			12	2
C05			40		20	2
C06				40	20	2
Total	60	60	40	40	100	

Note:Purely as anExample: Strength = 3 (if percentage >20%);
Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26HMC02	TAMILS AND TECHNOLOGY B.E. (Common to all Branches)		SEMESTER				II
Prerequisites		Category	HM	Credits			1
Basics of Tamil Language and Literature.		Hours/ Semester	L	T	P	SL	TH
			15	-	-	15	30
COURSE OBJECTIVES							
1.	To obtain the knowledge of weaving and ceramic technology.						
2.	To familiarize about design and construction technology during Sangam age and British period.						
3.	To know about the manufacturing technologies.						
4.	To obtain the knowledge of agriculture and irrigation technology.						
5.	To know about the development of Scientific Tamil and Tamil computing.						
UNIT - I	WEAVING AND CERAMIC TECHNOLOGY						3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.							
UNIT - II	DESIGN AND CONSTRUCTION TECHNOLOGY						3
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period							
UNIT - III	MANUFACTURING TECHNOLOGY						3
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads - Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.							
UNIT - IV	SCIENCE, TECHNOLOGY AND KNOWLEDGE SYSTEMS OF TAMILS						3
Agriculture and Irrigation Technology – Dam, Tank, Ponds and Sluice Systems – Significance of KumizhiThoompu of the Chola Period – Animal Husbandry and Wells Designed for Cattle Use – Agriculture and Agro-Processing – Knowledge of Sea and Ocean – Fisheries, Pearl and Conch Diving – Knowledge-Specific Society – 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.							
UNIT - V	ACTIVITY AND PROJECT WORK						3
Prepare of models/charts related to ancient Tamil technologies such as irrigation systems – shipbuilding - weaving, pottery – temples - and coin minting. Document and present on Tamil scientific and technological heritage based on literary – archaeological - and historical sources - undergo a Field visit to heritage sites – museums – temples - archaeological sites - handicraft centre’s - or traditional industries and submission of a field report. Study and digitally document of Tamil inscriptions - hero stones – temples - traditional occupations -or local heritage resources.							
L:15, SL :15, Total:30 Hours							

Weightage:

Continuous Assessment: 40%

End Semester Examinations: 60%

REFERENCE BOOKS:

1.	"History of the Tamils", P.T. Srinivasa Iyengar, Gyan Publishing House, 2020
2.	"Sangam Literature: Its Cults and Cultures", K.A. Nilakanta Sastri, Swathi Publications, 2006
3.	"History and Culture of Tamil Nadu", Chitra Madhavan, D.K. Print world, 2005
4.	"Tamil Computing", R. Ponnusamy, Allied Publishers Pvt. Ltd, 2025
5.	"Tamils and Technology", S Muthuramalingam, M Saravanakumar, Vijay Nicole Imprints Pvt. Ltd., 2024

E-RESOURCES:

1.	https://atlanticbooks.com/products/history-of-the-tamils-from-the-earliest-times-to-600-a-d-9788121235518
2.	https://books.google.co.in/books/about/Sangam_Literature_Its_Cults_and_Cultures.html?id=j1ZsnQEACAAJ&redir_esc=y
3.	https://books.google.co.in/books/about/History_and_Culture_of_Tamil_Nadu
4.	https://www.booksamillion.com/p/Tamil-Computing/R-Ponnusamy/9789390951055
5.	https://www.amazon.in/Tamils-Technology-English-S-Muthuramalingam/dp/8119243307

COURSE OUTCOMES (COs) /**At the end of the course, the students will have the ability to****Mapping
POs****Mapping
PSOs**

CO1	Obtain the knowledge about weaving and ceramic technology.	PO9	-
CO2	Familiarize about design and construction technology during Sangam age and British period.	PO9	-
CO3	Understanding about the manufacturing technologies.	PO9	PSO1
CO4	Acquire the skills in agriculture and irrigation technology.	PO9	-
CO5	Acquire the knowledge about the development of Scientific Tamil and Tamil computing.	PO9, PO11	PSO3
CO6	Develop an understanding of Tamil heritage through field-based and digital learning activities.	PO9, PO11	PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1									3					
CO2									3					
CO3									3			2		
CO4									3					
CO5									3		2			2
CO6									3		2			2

Activities:

1.	CO5: Acquire the knowledge about the development of Scientific Tamil and Tamil Computing 1. Prepare a report on the evolution of Scientific Tamil, highlighting key milestones and contributors. 2. Create a PowerPoint presentation on Tamil computing tools, including Tamil software, fonts, and digital platforms. 3. Demonstrate the use of online Tamil dictionaries, Tamil Virtual Academy, and Tamil Digital Library. 4. Conduct a hands-on activity on typing and formatting Tamil text using Unicode tools. 5. Group discussion on the role of Tamil in modern science and technology communication.
2.	CO6: Develop an understanding of Tamil heritage through field-based and digital learning activities 1. Organize a field visit to heritage sites, museums, temples and submit a detailed report with photographs. 2. Prepare a documentation project on local cultural heritage (architecture, crafts, inscriptions, or traditions). 3. Create a poster or chart on Tamil technological achievements (irrigation systems, shipbuilding, metallurgy) 4. Conduct a group seminar on Sangam age scientific and technological practices. 5. Develop a digital scrapbook or e-portfolio showcasing Tamil heritage elements, present a case study on any one ancient Tamil technology or knowledge system.

Rubrics for evaluation:CO5

Sl. No.	Criterion	Marks	Excellent (7-8)	Good(4-6)	Satisfactory (1-3)
1.	Knowledge of Tamil Heritage	8	Demonstrates and understanding of Tamil scientific, technological, and cultural heritage with accurate details.	Demonstrates good understanding with minor omissions.	Demonstrates basic understanding with limited details

2.	Historical Understanding	8	Clearly explains historical context and significance with relevant examples.	Explains historical context with some supporting examples.	Provides limited explanation of historical context.
3.	Contemporary Relevance	8	Effectively relates traditional knowledge and achievements to present-day applications and issues.	Relates traditional knowledge to modern applications with some clarity.	Identifies a few modern connections.
4.	Presentation Skills	8	Content is well-organized, visually appealing, and presented effectively.	Content is organized and presented clearly with minor shortcomings.	Content is organized and presented clearly with minor shortcomings.
5.	Communication Skills	8	Ideas are communicated clearly, confidently, and engagingly with appropriate supporting evidence.	Ideas are communicated clearly with moderate confidence and adequate support.	Communication is understandable but lacks clarity, confidence, or supporting evidence.
	Total	40			

Rubrics for evaluation:CO6

Sl. No.	Criterion	Marks	Excellent (7-8)	Good(4-6)	Satisfactory (1-3)
1.	Application of Knowledge	8	Effectively applies Tamil scientific, technological, and cultural concepts to practical tasks and projects.	Applies concepts correctly with minor guidance.	Applies concepts at a basic level with limited effectiveness.
2.	Project Execution	8	Project is comprehensive, innovative, well-planned, and successfully completed.	Project is well-executed with minor shortcomings.	Project meets minimum requirements but lacks depth or completeness.
3.	Use of Evidence and Resources	8	Effectively uses relevant data, sources and examples to support project outcomes.	Uses appropriate resources with adequate supporting evidence.	Uses limited resources and supporting evidence.
4.	Presentation Skills	8	Presents findings clearly, professionally, and effectively.	Presents findings clearly with minor shortcomings.	Presentation is adequate but lacks clarity, organization, or professionalism.
5.	Documentation Quality	8	Documentation is comprehensive, accurate, well-organized and properly formatted.	Documentation is complete and organized with minor omissions.	Documentation is adequate but lacks detail, accuracy, or proper organization.
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24			24	3
C03	12	12			12	2
C04	12	12			12	2
C05			40		20	2
C06				40	20	2
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26CEC01	ENGINEERING MECHANICS		SEMESTER				II	
Prerequisites			Category	ES(G)	Credits			4
			Hours/ Semester	L	T	P	SL	TH
				45	15	-	60	120
COURSE OBJECTIVES								
1.	To explain the importance of mechanics in the context of engineering and conservation equations.							
2.	To apply resolution of forces.							
3.	To explain the significance of centroid, center of gravity and moment of inertia.							
4.	To apply the different principles to study the motion of a body, and concept of relative velocity and acceleration.							
5.	To apply Impulse Momentum principle.							
UNIT - I	BASICS & STATICS OF PARTICLES							9+3
Introduction – Units and Dimensions – Laws of Mechanics – Lamé’s theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Equilibrium of a particle in three dimensions – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.								
UNIT - II	EQUILIBRIUM OF RIGID BODIES							9+3
Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.								
UNIT - III	PROPERTIES OF SURFACES AND FRICTION							9+3
Determination of Areas and Volumes –Theorems of Pappus and Guldinus -First moment of area and the Centroid of sections –Second and product moments of plane area of various sections –Parallel axis theorem and perpendicular axis theorem -Polar moment of inertia –Principal moments of inertia of plane areas -Principal axes of inertia - Frictional force -Laws of Coulomb friction -simple contact friction -Rolling resistance –Belt friction.								
UNIT - IV	KINEMATICS AND KINETICS OF PARTICLES							9+3
Displacement, Velocity and acceleration, their relationship -Relative motion -Newton’s low of motion -Work Energy Equation -Impulse and Momentum -Impact of elastic bodies.								
UNIT - V	KINEMATICS AND KINETICS OF RIGID BODIES							9+3
Plane motion - Absolute motion - Relative motion - Translating axes and Rolling Axes - Work and Energy - Impulse and Momentum.								
L:45, T:15, P:0, SL :60, Total:120 Hours								
Weightage:								
Continuous Assessment 40%								
End Semester Examinations 60%								

REFERENCE BOOKS:														
1.	Rajasekaran S and Sankara subramanian G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., 3rd Edition, 2017.													
2.	Bansal R.K., Engineering Mechanics, Laxmi Publications (P) Ltd., 8th Edition, 2015.													
3.	Palanichamy M.S. and Nagan S, Engineering Mechanics, Laxmi Publication(P) Ltd., 2022.													
4.	Beer F.P and Johnson Jr. E.R. Vector Mechanics for Engineers, Vol. 1 Statics and Vol. 2 Dynamics, McGraw –Hill International Edition, 12th Edition, 2019.													
5.	Dr.N.Kottiswaran., Engineering Mechanics., Sri Balaji Publications., 9 th Edition, Reprint 2010													
E-RESOURCES:														
1.	Moment of Inertia Calculator - https://skyciv.com/free-moment-of-inertia-calculator/													
2.	OpenStax - University Physics Volume 1- https://openstax.org/books/university-physics-volume-1/pages/10-4-moment-of-inertia-and-rotational-kinetic-energy													
3.	Engineering Mechanics, Dr. Dwarakish. G. S. - https://onlinecourses.swayam2.ac.in/ntr24_ed75/preview													
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to											Mapping POs		Mapping PSOs	
CO1	Understand the laws of mechanics for particle statics, equilibrium conditions for rigid bodies, surface properties including friction, and the kinematics and kinetics of both particles and rigid bodies.										-		-	
CO2	Apply vector operations for particle statics, support reactions for rigid body equilibrium, centroid and moment of inertia calculations, and motion principles for both particles and rigid bodies.										PO1, PO2, PO3		PSO2	
CO3	Analyze mechanical systems involving coplanar forces on particles, moments on rigid bodies, frictional resistance on surfaces, and the work-energy and impulse-momentum of particles and rigid bodies.										PO1, PO2, PO3, PO4		PSO2	
CO4	Evaluate engineering problems by integrating the statics of particles, equilibrium of rigid bodies, frictional surface properties, and the kinetics of particles and rigid bodies under various motions.										PO1, PO2, PO3, PO4, PO5		PSO2	
CO5	Perform a simple team activity to draw free-body diagrams and calculate forces for a basic real-world structure.										PO1, PO5, PO6, PO8, PO9		PSO1, PSO3	
CO6	Prepare a short assignment report on the practical applications of friction and motion in everyday life.										PO6, PO9, PO11		PSO2, PSO3	
The Course Articulation Matrix (CAM) for defined COs														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-	2	-
CO5	2	-	-	-	2	2	-	3	2	-	-	2	-	3
CO6	-	-	-	-	-	2	-	-	3	-	2	-	2	3

Activities:

1.	Conduct basic virtual experiments or build simple physical models to demonstrate equilibrium or friction (CO5)
2.	Chart preparation or mini-presentation on real-world applications of statics or dynamics in everyday life (CO6)

Rubrics for evaluation:CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Problem identification & free-body diagram	20	Free-body diagram is clearly drawn with all forces labeled	Diagram drawn, but some forces/labels are missing	Diagram is incomplete or incorrectly drawn
2.	Calculation of forces	30	Force calculations are accurate and clearly laid out	Calculations done, but contain minor mathematical errors	Calculations are incomplete or highly flawed
3.	Interpretation of results	20	Results are clearly interpreted with solid reasoning	Results are stated but with limited reasoning	Unclear or missing interpretation
4.	Report presentation	30	Report is clear, neat, and well-structured	Report is structured, but needs formatting improvement	Poorly structured or untidy report
	Total	100			

Rubrics for evaluation:CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Understanding of friction & motion	20	Clearly explains the practical aspects of friction and motion	Explanation is basic and needs minor improvement	Very limited understanding shown
2.	Safety & real-world application	30	Clearly discusses how friction/motion impacts safety in daily life	Safety aspects mentioned but loosely connected to the topic	Poorly explained or omitted
3.	Evidence of team effort & learning	30	Clear evidence of collaborative work and good use of references	Basic team effort with limited outside references	Very limited effort and no references
4.	Presentation & Communication	20	Assignment is clearly communicated and well-written	Writing is decent but needs grammatical improvement	Poorly written and structured
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24	-	-	24	3
C03	12	12	-	-	12	2
C04	12	12	-	-	12	2
C05	-	-	40	-	20	2
C06	-	-	-	40	20	2
Total	60	60	40	40	100	

Note:Purely as anExample: Strength = 3 (if percentage >20%);
Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MEC02	ENGINEERING PRACTICES LABORATORY		SEMESTER				II	
Prerequisites			Category	SD	Credits			2
Fundamental understanding of measurement tools and safety procedures			Hours/ Semester	L	T	P	SL	TH
				0	0	45	15	60
COURSE OBJECTIVES								
1.	To provide hands-on exposure in basic manufacturing and fabrication practices.							
2.	To develop practical skills in carpentry, fitting, plumbing and sheet metal operations.							
3.	To train students in machining, welding and foundry practices.							
4.	To develop problem solving, safety awareness and teamwork skills through laboratory activities.							
LIST OF EXPERIMENTS								
1.	SAFETY & WORKSHOP PRACTICES Study of workshop safety measures, PPE and first aid practices. Demonstration of workshop tools, measuring instruments and machine shop practices.							4
2.	FITTING AND CARPENTRY PRACTICES Preparation of Half-Lap / T-Joint / Dovetail Joint using carpentry tools and wooden workpieces Preparation of V-fitting Square and Curve fitting using mild steel specimen.							14
3.	SHEET METAL AND PLUMBING PRACTICES Preparation of Square Tray / Cylinder / Conical Funnel using GI sheet. Preparation of Single Seam and Double Seam joints. Preparation of PVC pipe connections and saddle connection.							14
4.	FOUNDRY AND WELDING PRACTICES Green sand preparation and mould cavity preparation using foundry tools. (Single and Split Patterns) Demonstration and practice of Arc welding of Butt, Lap and T-joints.							14
5.	MACHINING PRACTICES Lathe operations – Facing, Turning, Chamfering, Knurling and Taper turning. Drilling and Tapping operations on mild steel specimen.							14
P:45, SL:15, Total:60 Hours								
Weightage: Continuous Assessment 60% End Semester Examinations 40%								
REFERENCE BOOKS:								
1.	Bawa, H.S, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.							
2.	Jeyachandran.K, Natarajan.K and Balasubramanian.S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.							
3.	Jeyapoovan.T, SaravanaPandian.M, and Pranitha.S, "Engineering Practices Lab Manual", Vikas Publishing House Pvt. Ltd, 2006.							
4.	Dr. P.Kannan, Mr. T.Satheeskumar & Mr.K.Rajasekar, "Engineering practices laboratory" Mnuual first edition 2017.							
5.	Dr. V. Rameshbabu "Engineering practices laboratory" VRB publication pvt Id.							

E-RESOURCES:

1. [Virtual Labs - NPTEL Labs for Mechanical Engineering](#)

COURSE OUTCOMES (COs) /**At the end of the course, the students will have the ability to****Mapping
POs****Mapping
PSOs**

CO1	Explain safety procedures, workshop tools and engineering practices used in manufacturing environments.	PO1, 2, 5, 6, 7, 8, 10	PSO1
CO2	Construct wooden and metal fitting joints using appropriate carpentry and fitting tools.	PO1, 2, 3, 5, 9	PSO1, PSO2
CO3	Fabricate sheet metal and plumbing components using suitable tools and techniques.	PO1, 2, 3, 5, 9	PSO1, PSO2
CO4	Perform welding and foundry operations to manufacture engineering components.	PO1, 2, 3, 4, 5, 9	PSO1, PSO2
CO5	Perform various machining operations in mild steel rod by operating lathe and drilling machines	PO1, 2, 3, 4, 5, 8, 9, 10, 11	PSO1, 2, 3
CO6	Develop a model product using practical engineering skills, teamwork and problem-solving ability through workshop practices and self-learning activities.	PO1, 2, 3, 4, 5, 8, 9, 10, 11	PSO1, 2, 3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO01	PSO02	PSO03
CO1	3	2	-	-	1	2	2	3		1	-	1	-	-
CO2	3	3	2	-	2	--	-	-	2	-	-	3	2	-
CO3	3	3	3	-	2	-	-	-	2	-	-	3	2	-
CO4	3	3	3	2	2	-	-	-	2	-	-	3	3	-
CO5	3	2	2	1	3	2	1	-	1	-	-	2	3	1
CO6	2	3	2	1	1	-		2	3	3	2	2	2	3

Activities:

1. Design and Fabrication of a Multi-Utility Tool Stand
2. Design and Fabrication of a Portable Study Lamp with Storage Box

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Safety Practices & Discipline	20	Consistently follows all safety procedures independently	Uses tools accurately and independently with high proficiency	Follows safety procedures inconsistently
2.	Tool Handling & Technical Skills	20	Uses tools accurately and independently with high proficiency	Uses tools correctly with occasional support	Uses tools with frequent assistance
3.	Execution of Practical Work	25	Produces accurate work meeting specifications with excellent finish	Produces acceptable work with minor errors	Produces work with noticeable errors requiring correction
4.	Problem Solving & Application Skills	15	Identifies and solves problems independently with innovative approach	Identifies and solves problems independently with innovative approach	Requires continuous support for solving problems
5.	Teamwork & Participation	10	Actively contributes and works effectively in teams	Participates adequately in team activities	Limited participation in teamwork
6.	Documentation & Self-Learning	10	Well-maintained records with additional learning inputs	Records maintained with minor omissions	Incomplete records with limited learning evidence
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Evaluation of Student Work, Observation of Record and Model Test	Activity	Percentage allocation	Mapping Strength
CO1	20		10	2
CO2	20		10	2
CO3	20		10	2
CO4	20		10	2
CO5	20		10	2
CO6		100	50	2
Total	100	100	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26EEEC01	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING			SEMESTER			II		
Prerequisites				Category	ES(G)	Credits		4	
Physics				Hours/ Semester	L	T	P	SL	TH
					45	0	45	30	120
COURSE OBJECTIVES									
1.	To impart foundational knowledge in principles and applications of electrical and electronics engineering.								
UNIT – I	DC CIRCUITS								18
Electrical circuit elements: Resistor (R), Inductor (L) and Capacitor (C) – Independent Voltage and Current Sources – Ohm’s Law and Kirchhoff’s Laws – Resistance in Series and Parallel Circuits – Voltage Division and Current Division Rules – Analysis of simple electrical circuits with DC excitation using fundamental laws (Mesh and Nodal Analysis) – Superposition Theorem – Thevenin’s Theorem. Practical: Verification of Kirchhoff’s Law, Superposition theorem and Thevenin’s theorem. Measurement of time constant of Series / Parallel R-C circuit. Activities: Solving Problems in DC electric circuits.									
UNIT – II	AC CIRCUITS								18
Introduction to Single-Phase AC Circuits – Representation of Sinusoidal Waveforms: Average Value, RMS Value, Form Factor, Peak Factor and Phasor Representation – Analysis of Single-Phase AC Circuits consisting of RL, RC, and RLC Series Combinations: Impedance, Power factor, Power and Phasor diagram, Three-Phase AC Circuits: Voltage and Current Relationships in Balanced Star and Delta Connections. Practical: Sinusoidal steady state response of Series RL, and RC circuits – measurement of impedance and power factor. Measurement of three-phase power by two wattmeter method in three-phase circuits. Study of Resonance in Series RLC Circuit. Activities: Solving Problems in AC electric circuits.									
UNIT – III	ELECTRICAL MACHINES AND TRANSFORMERS								18
Construction, Principle of Operation, Types, Characteristics and Applications: DC Motor (Shunt and Series), BLDC Motor, Three-Phase Induction Motor, Single-Phase Induction Motors (Split-Phase and Capacitor-Start Capacitor-Run Type), Transformers (Core and Shell type). Practical: Speed control of DC shunt motor & Load test on DC shunt motor. Load test on single-phase transformer Measurement of core loss and full load copper loss in a single-phase transformer. Activities: Demonstration of working of DC and AC motor starters. Virtual demonstration of electrical machines and transformers.									

UNIT – IV	BASICS OF ELECTRONIC DEVICES, SENSORS AND TRANSDUCERS	18
Basic Structure of Semiconductor Devices – PN Junction Diode and Zener Diode – V-I Characteristics and Applications; Bipolar Junction Transistor (BJT): CE, CB, and CC Configurations and Working Principle – Operational Amplifier: Principle of Operation, Characteristics and Applications, Inverting and Non-Inverting, Summing and Differential Amplifiers. Practical: V-I characteristics of PN junction diode and Zener diode. Activities: Virtual Demonstration of Hall Effect, Piezoelectric and Smart Sensors. Virtual Demonstration of LVDT, Optical and digital transducer.		
UNIT – V	BASICS OF POWER SYSTEMS, MEASUREMENTS AND WIRING	18
Structure of Electrical Power Systems: Generation, Transmission, and Distribution – Earthing and Methods of Earthing – Protective Devices: SFU, MCB, MCCB, and ELCB. Functional Elements of Measuring Instruments – Construction and Working Principle of Moving-Coil and Moving-Iron Instruments. Practical: Demonstration of House wiring, Stair-case wiring and Fluorescent lamp wiring. Study of basic electrical safety precautions and use of measuring instruments such as voltmeter, ammeter and multimeter. Activities: Physical demonstration of House Wiring tools and components. Physical Demonstration of Types of House Wiring. Physical demonstration of Types of Wires and Cables.		
L:45, P :45, SL :30, Total:120 Hours		
Weightage: Continuous Assessment 50% End Semester Examinations 50%		
TEXT BOOKS:		
1.	Kothari, D. P., and Nagrath, I. J., "Basic Electrical Engineering", Tata McGraw Hill, 2010.	
2.	Muthu Subramaniam. R., Salivaganan. R., and Muralidharan. K. A., "Basic Electrical and Electronics Engineering", Second Edition, Tata McGraw Hill, 2010.	
3.	Kulshreshtha. D.C., "Basic Electrical Engineering", Tata McGraw Hill, 2009.	
4.	Theraja, B. L., and Theraja, A. K., "A Textbook of Electrical Technology, Vol. I: Basic Electrical Engineering", S. Chand Publishing, 2014.	
REFERENCE BOOKS:		
1.	Mehta. V. K., and Mehta, Rohit, "Principles of Electrical Engineering", S. Chand Publications, 2008.	
2.	Hughes. E., "Electrical and Electronics Technology", Pearson, 2010.	
3.	Bobrow. L. S., "Fundamentals of Electrical Engineering", Oxford University Press, 2011.	
E-RESOURCES:		
1.	https://nptel.ac.in/courses/117106108	

COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Analyze the basic DC and AC electric circuits.	PO2	
CO2	Apply electromagnetic principles to interpret the working of electrical machines and transformers.	PO1	
CO3	Analyze the operation and characteristics of electronic devices.	PO2	
CO4	Choose appropriate protective devices, earthing and measuring instruments in power system for safe electrical installation.	PO5, PO11	
CO5	Apply knowledge of fundamental laws and theorems for solving problems in DC and AC electric circuits.	PO1, PO3, PO11	
CO6	Make an effective technical seminar presentation as a Team: Measuring instruments, sensors and transducers, Types of House wiring, Types of wires and Cable, DC and AC motor starters.	PO8, PO9, PO11	

The Course Articulation Matrix (CAM) for defined Cos

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 01	PSO 02	PSO 03
CO1		3												
CO2	3													
CO3		3												
CO4					3						2			
CO5	3		3								2			
CO6								3	3		2			

Activities:

1.	Solving Problems in DC and AC electric Circuits. (CO5)
2.	Technical Seminar Presentation on Measuring instruments, sensors and transducers, Types of House wiring, Types of Wires and Cable, DC and AC motor starters. (CO6)

List of Experiments

	COs
1. Study of basic electrical safety precautions and use of measuring instruments such as voltmeter, ammeter, and multimeter.	CO4
2. Verification of Kirchhoff's Law.	CO1
3. Verification of Superposition / Thevenin's Theorem	CO1
4. Sinusoidal Steady-State Response of R-L and R-C Circuits – Impedance and Power factor Calculation and Verification / Study of Resonance in Series RLC Circuit/ Measurement of Time Constant of an R-C Circuit.	CO1
5. Measurement of Three-Phase Power by Two-Wattmeter Method in Three-Phase Circuits	CO1
6. Load Test on DC Shunt Motor.	CO2
7. Speed Control of DC Shunt Motor	CO2

8.	Load Test on Single-Phase Transformer.	CO2
9.	Measurement of Core Loss and Full-Load Copper Loss in a Single-Phase Transformer	CO2
10.	V-I Characteristics of PN Junction Diode / Zener Diode.	CO3
11.	Demonstration of House Wiring, Staircase Wiring and Fluorescent Lamp Wiring.	CO4

Rubrics for evaluation: CO5 Solving Problems in DC and AC electric circuits.

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Problem Understanding	25	Correctly interprets the problem and identifies the required parameters independently	Understands the problem with minor guidance	Requires significant guidance to understand the problem
2.	Formula Selection and Application	25	Selects and applies appropriate formulas/concepts accurately	Minor errors in formula selection or application	Incorrect or incomplete application of formulas
3.	Calculation Accuracy	25	Performs calculations accurately with correct units and logical steps	Minor calculation or unit errors	Frequent errors resulting in incorrect answers
4.	Result Interpretation and Presentation	25	Presents solutions systematically with correct interpretation and conclusions	Minor errors in presentation or interpretation	Incomplete or incorrect presentation and interpretation
	Total	100			

Rubrics for evaluation: CO6 - Technical Seminar Presentation on Instruments, Transducers, Sensors, and House Wiring.

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Technical Understanding	25	Demonstrates clear and thorough understanding of the topic	Demonstrates moderate understanding	Demonstrates basic understanding only
2.	Presentation and Communication Skills	25	Presents ideas clearly, confidently, and effectively	Presentation is understandable with minor issues	Presentation lacks clarity/confidence
3.	Report/Content Organization	25	Well-structured report/presentation with proper technical content	Adequate organization with minor errors	Poorly organized content/report
4.	Participation and Activity Involvement	25	Actively participates and contributes independently	Participates with occasional support	Limited participation and involvement
	Total	100			

Laboratory Experiment Evaluation

Sl. No	Criterion	Marks	Excellent	Good	Satisfactory
1.	Aim	5	Have excellent knowledge on necessities of experiment. (5 or 4)	Have acceptable knowledge on necessities of experiment. (3 or 2)	Poor knowledge on necessities of experiment. (1)
2.	Identification of apparatus/ Software / Materials need.	5	Highly capable of conducting experiment, with minimal or no support. (5 or 4)	Able to conduct experiment with quantifiable support. (3 or 2)	Unable to conduct experiment. (1)
3.	Experimentation	15	Clearly able to define output and conclude result. (13 to 15)	Able to define output but not able to conclude result. (8 to 12)	Poor ability to define output. (1 to 7)
4.	Observation & Result	15	On-time legibly written record with all requirements and without mistake. (13 to 15)	On-time legibly written record but not with all requirements and without mistake. (8 to 12)	Poorly written record. (1 to 7)
5.	Record	5	Answered almost all questions. (5 or 4)	Answered some of the questions. (3 or 2)	Answered a few questions. (1)
6.	Viva voice	5	Have excellent knowledge on necessities of experiment. (5 or 4)	Have acceptable knowledge on necessities of experiment. (3 or 2)	Poor knowledge on necessities of experiment. (1 or 0)
	Total	50			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Theory Component				Laboratory Component		Percentage allocation	Mapping Strength
	Test I	Test II	Activity I	Activity II	Observation and Record	Test		
C01	12	12	-	-	12	2	12	12
C02	24	24	-	-	24	3	24	24
C03	16	16	-	-	16	2	16	16
C04	8	8	-	-	8	1	8	8
C05	-	-	40		25	3	-	-
C06	-	-	-	40	25	3	-	-
Total	60	60	40	40	100		60	60

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MAC04	PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES B.E. (Common to CIVIL, ECE, MECH & METT)				SEMESTER			III	
Prerequisites				Category	BS	Credits			3
Basic knowledge of calculus, differential equations, complex numbers and elementary vector calculus.				Hours/ Semester	L	T	P	SL	TH
					45	15	-	30	90
COURSEOBJECTIVES									
1.	To understand the formation and solution methods of partial differential equations including first order and higher order linear equations.								
2.	To develop knowledge in solving boundary value problems using Fourier series and separation of variables techniques for heat and wave equations.								
3.	To acquire understanding of analytic functions, harmonic functions and conditions for analyticity in complex analysis.								
4.	To learn conformal mapping techniques and standard complex transformations used in mathematical and engineering applications.								
5.	To understand complex integration methods, residue theorem and contour integration techniques for evaluating complex and real integrals.								
UNIT- I		PARTIAL DIFFERENTIAL EQUATIONS							9+3
Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Lagrange’s Linear equation – Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.									
UNIT- II		APPLICATIONS OF FOURIER SERIES TO PARTIAL DIFFERENTIAL EQUATION							9+3
Classification of partial differential equations- Method of separation of variables – Solutions of one-dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation.									
UNIT - III		ANALYTIC FUNCTIONS							9+3
Analytic functions – Necessary and sufficient conditions for analyticity - Properties of analytic functions – Harmonic conjugates – Construction of analytic function.									
UNIT - IV		CONFORMAL MAPPING							9+3
Introduction to complex mapping - Conformal mapping – Condition for conformality – Standard mappings: $a + z, az, az + b, \frac{1}{z}, z^2, ez$ and Bilinear transformations.									
UNIT - V		INTEGRATION OF COMPLEX FUNCTIONS							9+3
Line integral - Cauchy’s integral theorem – Cauchy’s integral formula – Taylor’s and Laurent’s series – Singularities – Residues – Cauchy’s Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contours (excluding poles on real lines).									
L:45, T:15, SL:30, Total: 90 Hours									
Weightage:									
Continuous Assessment: 40%									
End Semester Examinations: 60%									

TEXT BOOKS:				
1.	Erwin Kreyszig "Advanced Engineering Mathematics", John Wiley & Sons. , New Delhi, 2015.			
2.	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 45 th Edition, New Delhi, 2020.			
REFERENCE BOOKS:				
1.	Wylie C. R. and Barrett L. C, "Advanced Engineering Mathematics", Tata McGraw-Hill., New Delhi, 2019.			
2.	Peter V.O Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt. Ltd., New Delhi, 2016.			
3.	Dennis G Zill, "Advanced Engineering Mathematics", Jones & Bartlett India P Ltd., New Delhi, 2017.			
E-RESOURCES:				
1.	NPTEL, "Partial Differential Equations", National Programme on Technology Enhanced Learning, https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ma28			
2.	NPTEL, "Complex Analysis", National Programme on Technology Enhanced Learning, https://nptel.ac.in/courses/111107056			
3.	MIT OpenCourseWare, "Differential Equations", Massachusetts Institute of Technology, https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/			
4.	Paul's Online Math Notes, "Partial Differential Equations and Complex Variables", Lamar University, https://tutorial.math.lamar.edu/classes/de/intropde.aspx			
5.	Wolfram Math World, "Partial Differential Equations, Analytic Functions, Conformal Mapping and Residue Theorem", Wolfram Research, https://mathworld.wolfram.com/AnalyticFunction.html			
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Remember and understand the fundamental concepts and methods of partial differential equations, Fourier series applications, analytic functions, conformal mappings and complex integration, including PDE solution techniques, analyticity conditions, harmonic functions, mapping transformations, complex series expansions, and residue theory.		--	--
CO2	Apply the techniques of partial differential equations, Fourier series, analytic functions, conformal mappings and complex integration to solve mathematical and engineering problems involving heat and wave equations, complex transformations, contour integration and evaluation of real integrals using residue theory.		PO1	PSO1
CO3	Analyze mathematical and engineering problems using partial differential equations, Fourier series methods, analytic functions, conformal mappings and complex integration by selecting suitable analytical techniques, interpreting complex transformations, and examining the behaviour of functions and solutions in applied contexts.		PO2	PSO1
CO4	Develop mathematical models and analytical solution strategies using partial differential equations, Fourier methods, and complex analysis techniques for solving engineering and physical science problems.		PO3	PSO2
CO5	Investigate and solve assignment-based and application-oriented problems involving PDEs, conformal mappings and contour integration to enhance analytical reasoning and computational skills.		PO5	PSO2

C06	Communicate mathematical concepts, analytical solution procedures, graphical interpretations and results related to partial differential equations and complex analysis effectively through proper mathematical notation, assignments, presentations and structured report writing.	PO10	--
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The Course Articulation Matrix (CAM) for defined COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO1	PSO2	PSO3
C01														
C02	3											3		
C03		2										2		
C04			1										1	
C05					3								1	
C06										3				
Avg	3	2	1		3					3		2.5	1	

Activities:

1.	Students shall solve selected assignment-based problems involving partial differential equations, Fourier series applications, analytic functions, conformal mappings and contour integration using suitable analytical and computational methods. This activity develops analytical reasoning, computational skill, and problem-solving ability in applied mathematics.
2.	Students shall prepare a short report or presentation on selected applications of PDEs, conformal mappings, analytic functions or residue theorem. This activity develops the ability to communicate mathematical procedures, graphical interpretations, results and conclusions effectively using proper notation and structured report writing.

Rubrics for evaluation: C05

Sl. No.	Criterion	Marks	Excellent (7-8)	Good (4-6)	Satisfactory (1-3)
1.	Selection of problem	8	Suitable application-based problem is selected and clearly understood	Problem is relevant, but needs minor clarity	Problem selection is basic or unclear
2.	Application of analytical method	8	Correct method is applied with proper steps	Method is mostly correct with minor errors	Method is incomplete or incorrect
3.	Accuracy of solution	8	Solution is accurate and well-presented	Minor errors are present	Major errors in solution
4.	Interpretation of results	8	Results are clearly interpreted with conclusion	Interpretation is limited	Interpretation is weak or missing

5.	Presentation and documentation	8	Work is neatly organized with clear numerical presentation and documentation	Presentation is good with minor organizational issues	Presentation is satisfactory but lacks consistency
	Total	40			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (9-10)	Good (6-8)	Satisfactory (1-5)
1.	Clarity of explanation	8	Concepts and procedures are clearly explained	Explanation is understandable with minor gaps	Explanation is unclear
2.	Use of notation, diagrams and representation	8	Proper notation, diagrams, graphs and outputs are used	Minor errors in notation or representation	Poor or missing representation
3.	Organization of report/ presentation	8	Well-structured and neatly presented	Organized, but needs improvement	Poorly organized or incomplete
4.	Communication of results	8	Results and conclusions are communicated effectively	Communication is adequate, but limited	Communication is weak
5.	Overall presentation and academic quality	8	Work demonstrates excellent academic quality and professionalism	Academic quality is good with minor issues	Academic presentation is satisfactory
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	12	12	-	-	12	2
CO2	24	24	-	-	24	3
CO3	16	16	-	-	16	2
CO4	8	8	-	-	8	1
CO5	-	-	40	-	25	3
CO6	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);

Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MT301	PHYSICAL METALLURGY – I		SEMESTER				III	
Prerequisites			Category	ES(PC)	Credits			3
Engineering Physics			Hours/ Semester	L	T	P	SL	TH
				45	0	0	45	90
COURSE OBJECTIVES								
1.	Identify and describe fundamental crystal structures (BCC, FCC, HCP) and calculate parameters like unit cell, lattice parameter, atomic packing factors and crystallographic planes							
2.	To learn about the presence of different kinds of defects in crystal structures							
3.	Explain diffusion mechanisms and solidification phenomena occurring in metals and alloys							
4.	Interpret phase diagrams and apply phase equilibrium principles to predict microstructures in alloy systems.							
5.	Be familiar with phase diagram including iron- carbon diagram and its microconstituent, classification of steels and cast irons and the effects cold and hot working process							
UNIT - I		CRYSTAL STRUCTURES						9
Review of atomic bonds, Lattice, unit cell, crystal systems and Bravais lattices; Principal crystal structures – BCC, FCC, HCP and its characteristics; Miller indices for crystallographic planes and directions, interplanar spacing; Volume, planar and linear atomic density; Polymorphism and allotropy; CsCl, NaCl, Diamond structures; single crystal and polycrystalline and amorphous materials; isotropy and anisotropy; Simple problems in the above topics.								
UNIT - II		CRYSTALLINE IMPERFECTIONS						9
Types of point defects, effect of temperature on vacancy concentration, interstitial sites: octahedral and tetrahedral sites; Line defects – dislocations – Edge, screw and mixed dislocations, Burger’s vector, slip and twinning; Planar defects – grain boundaries, tilt boundaries, small angle grain boundaries; ASTM grain size number, grain size determinations; Volume defects; Simple problems in the above topics.								
UNIT- III		ATOMIC DIFFUSION IN SOLIDS AND SOLIDIFICATION OF METALS						9
Diffusion mechanisms, steady state diffusion and non-steady state diffusion-Fick’s first law and second law; Kirkendall effect and Draken’s equation; Factors affecting diffusion; Industrial applications of diffusion processes; Simple problems in the above topics; Basic principles of solidification of metals and alloys; Growth of crystals– Planar growth, dendritic growth, Solidification time, dendrite size; Cooling curves; Cast or Ingot structure, Solidification defects – Control of casting structure; Directional solidification – single crystal growth; Simple problems in the above topics.								
UNIT- IV		PHASE DIAGRAMS						9
Phases, solid solution types, compounds, Hume- Rothery rules; Gibb’s phase rule; Phase diagram determination; Binary isomorphous alloy systems – composition and amount of phases, development of microstructure – equilibrium and non-equilibrium cooling- Coring and its effects, homogenization; Binary eutectic system - composition and amount of phases, development of microstructure; Eutectoid, Peritectic and monotectic reaction, Phase diagrams with intermediate phases and compounds; Ternary phase diagrams. Simple problems in the above topics.								
UNIT - V		IRON-CARBON PHASE DIAGRAM, COLD WORKING AND HOT WORKING						9
Iron-carbon diagram, Phases in Fe-C system, Invariant reactions, Microstructure of slowly cooled steels, composition and amount of phases, Effect of Alloying elements on Fe-C system, Type, structure, properties and applications of Plain Carbon Steels and different types of Cast iron; IS Specification for Steels and Cast Irons, Cold working –Structure and Properties of cold worked metals, Effect of mechanical properties and microstructures, Annealing textures. Hot working – Concept of hot working, Comparisons with cold working and warm working, Simple problems in above topics.								

Weightage:

Continuous Assessment 40%

End Semester Examinations 60%

REFERENCE BOOKS:

1.	Donald R. Askeland, "The Science and Engineering of Materials", Thomson Learning, India Edition, 2007.
2.	William D. Callister, "Materials Science and Engineering – An Introduction", 4th edition, John Wiley & Sons, New York, USA, 1997.
3.	Avner S H. "An Introduction to Physical Metallurgy", McGraw Hill Book Co, New York, USA, 1997.
4.	Donald R. Askeland, "Essentials of Material Science and Engineering ", Thomson Learning, India Edition, 2007.
5.	Raghavan V., "Physical Metallurgy – Principles and Practice", Prentice Hall of India Ltd., New Delhi, 1996.

E-RESOURCES:

1.	www.matter.org / https://phet.colorado.edu/en/simulations/diffusion
2.	www.doitpoms.ac.uk
3.	www.msestudent.com
4.	http://www.digimat.in/nptel/courses/video/113105024/L01.html / http://www.digimat.in/keyword/113.html / http://www.digimat.in/cgi-bin/search.cgi
5.	https://www.library.cbit.ac.in/OpenAccess-Courseware.htm

COURSE OUTCOMES (COs) /**At the end of the course, the students will have the ability to****Mapping
POs****Mapping
PSOs**

CO1	Explain the various fundamental concepts in crystal systems, crystalline defects, diffusion in metals and alloys, phase diagrams and various microconstituents.	--	PSO1, PSO2
CO2	Apply the fundamental principles of crystallographic planes, various atomic densities, diffusion and solidification behaviour, equilibrium diagrams and working of metals.	PO1	PSO2, PSO3
CO3	Analyze the crystal structure characteristics, grain size determinations, growth of crystals, invariant reactions and classifications of iron and steels	PO2, PO3	PSO1, PSO3
CO4	Analyze the given phase diagram and identify the reactions, phase transformations and present the findings through tables and diagrams.	PO5	PSO2, PSO3
CO5	Study torsional analysis of various components such as shafts, pressure vessels and springs through self-learning activities and present the findings while considering societal and economic impacts.	PO6, PO9, PO10, PO11	PSO2, PSO3
CO6	Survey the materials analysis of various components such as shafts, pressure vessels and springs through self-learning activities and present the findings while considering societal and economic impacts.	PO6, PO9, PO10, PO11	PSO1, PSO2, PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
CO1	3											3		
CO2	3	2										2	2	
CO3	3	3		2								2		
CO4		3		3	2							2	2	
CO5		2	3		3		2						3	2
CO6	3		3		3				2	2	2	2	3	3

Activities:

1.	Technical Poster on Phase Transformations and Microstructural Development in Engineering Alloys
2.	Technical Seminar Presentation on Recent Advances in Physical Metallurgy and Advanced Engineering Materials (Independent Study)

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (14–20)	Good (7–13)	Satisfactory (1–6)
1.	Technical Content	20	Comprehensive and technically accurate	Adequate coverage	Limited coverage
2.	Understanding of Metallurgical Concepts	20	Excellent understanding demonstrated	Good understanding	Basic understanding
3.	Organization and Presentation	20	Well-organized and logically structured	Adequately organized	Poor organization
4.	Visual Effectiveness	20	Clear and attractive presentation	Adequate visual presentation	Limited visual appeal
5.	Response to Questions	20	Accurate and confident responses	Adequate responses	Limited responses
Total		100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (14–20)	Good (7–13)	Satisfactory (1–6)
1.	Technical Depth	20	In-depth understanding and analysis	Adequate technical depth	Limited technical depth
2.	Literature Survey	20	Comprehensive review of literature	Adequate review	Limited review
3.	Presentation Skills	20	Excellent communication and delivery	Good communication	Average communication
4.	Technical Discussion	20	Effective discussion with critical analysis	Adequate discussion	Limited discussion

5.	Report Quality	20	Professional quality report	Acceptable report	Poor documentation	
Total		100				
The Internal Assessment Matrix (IAM) for the defined COs:						
CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	12	12	-	-	12	2
CO2	24	24	-	-	24	3
CO3	16	16	-	-	16	2
CO4	8	8	-	-	8	1
CO5	-	-	40		25	3
CO6	-	-	-	40	25	3
Total	60	60	40	40	100	
Note: Purely as an Example: Strength = 3 (if percentage >20%); Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);						

26MT302	MINERALS, FUELS AND FURNACES		SEMESTER				III	
Prerequisites			Category	ES(PC)	Credits		3	
Engineering Chemistry			Hours/ Semester	L	T	P	SL	TH
				45	0	0	45	90
COURSE OBJECTIVES								
1.	To understand the principles, operations and equipment used in mineral dressing and ore beneficiation.							
2.	To acquire knowledge of crushing, grinding, sizing, classification and concentration techniques employed in mineral processing.							
3.	To study the classification, properties, testing and applications of solid, liquid and gaseous fuels.							
4.	To understand the construction, operation, efficiency and heat recovery systems of industrial furnaces.							
5.	To gain knowledge of refractory materials, their properties, manufacturing processes, testing methods and industrial applications.							
UNIT – I		MINERAL DRESSING – I						9
Introduction to mineral dressing – Minerals, ores, physical characteristics of ores relevant to mineral dressing, industrially important minerals; Sampling of ores; Comminution – Crushing and Grinding - Jaw, gyratory, cone and roll crushers – ball, rod, vibratory and hammer mills - Closed and open circuit grinding – dry and wet grinding. Power requirement calculations for crushing and grinding, Rittinger's law; Sizing, Industrial screening								
UNIT - II		MINERAL DRESSING – II						9
Chemical processing of ores – leaching, ion exchange and liquid-solvent extraction. Classification – Principles and laws of classification – theory of settling; Types of classifiers – mechanical, hydraulic and hydrocyclone. Gravity concentration – Principles, Jigs, spirals, shaking tables; Heavy media separation – principles, separating media and vessels; Froth flotation – principle, operation and machines; Magnetic separation, Electrostatic separation; Thickeners and filters.								
UNIT- III		FUELS AND THEIR PROPERTIES						9
Classification of fuels – Solid, Liquid and Gaseous fuels; Coal – Classification, manufacture of metallurgical coke and its properties; Petroleum – Classification and composition of crude petroleum; Gaseous fuels – Natural gas, Coal gas, Producer gas, Water gas, Blast furnace gas – manufacture, properties and applications; Testing of fuels; Combustion calculations and air requirement for combustion.								
UNIT- IV		FURNACES						9
Introduction and classification of furnaces; Measurement of temperature and pressure; Thermal efficiency; Heat balance calculations; Melting and heat treatment furnaces – Crucible furnace, Reverberatory furnace, Cupola furnace, Rotary furnace, Induction furnaces, Arc furnaces, Resistance furnaces, Batch and Continuous furnaces; Heat recovery devices – Recuperators and Regenerators; Industrial burners.								
UNIT - V		REFRACTORIES						9
Introduction and classification of refractories – Acid, Basic and Neutral refractories; Properties and testing of refractories; Raw materials, manufacture, properties and applications of silica, fireclay, alumina, magnesite, dolomite, chromite, chrome-magnesite, magnesite-chrome, carbon, graphite refractories, refractory cement, ramming mixes and castables.								
L:45, SL :45, Total:90 Hours								

Weightage:

Continuous Assessment 40%

End Semester Examinations 60%

REFERENCE BOOKS:

1.	Gupta, O.P., <i>Elements of Fuels, Furnaces and Refractories</i> , 6th Edition , Khanna Publishers, New Delhi, 2018.
2.	Gaudin, A.M., <i>Principles of Mineral Dressing</i> , McGraw-Hill Book Company , New York, Reprint Edition, 2017 (Original Edition: 1939).
3.	Gilchrist, J.D., <i>Extraction Metallurgy</i> , 2nd Edition , Pergamon Press, London, 1981.
4.	Wills, B.A. and Finch, J.A., <i>Wills' Mineral Processing Technology: An Introduction to the Practical Aspects of Ore Treatment and Mineral Recovery</i> , 9th Edition , Butterworth-Heinemann, Oxford, 2016.
5.	Fuerstenau, M.C. and Han, K.N., <i>Principles of Mineral Processing</i> , 1st Edition , Society for Mining, Metallurgy and Exploration (SME), USA, 2003.
6.	Jain, S.K., <i>Ore Processing</i> , Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1986.

E-RESOURCES:

1.	NPTEL Course on Mineral Processing – https://nptel.ac.in/courses/113104008
2.	NPTEL Course on Mineral Beneficiation – https://nptel.ac.in/courses/113104060
3.	NPTEL Course on Fuels and Furnaces – https://nptel.ac.in/courses/113104058
4.	SME Technical Resources – https://www.smenet.org

COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Identify the basic concepts of mineral dressing, beneficiation, fuels, furnaces, and refractories used in metallurgical industries.	---	PSO1, PSO2
CO2	Use mineral processing methods, fuel properties, furnace operations, and refractory materials in metallurgical applications.	PO1	PSO1, PSO2, PSO3
CO3	Examine mineral beneficiation processes, fuel characteristics, furnace systems, and refractory performance in industrial practice.	PO2, PO3	PSO1, PSO3
CO4	Investigate the influence of mineral characteristics, fuels, furnaces, and refractories on metallurgical performance.	PO2, PO5	PSO2, PSO3
CO5	Justify the selection of mineral processing methods, fuels, furnaces, and refractories for industrial applications.	PO2, PO3, PO6, PO10, PO11	PSO2, PSO3
CO6	Design integrated metallurgical processing systems involving beneficiation techniques, fuels, furnaces, and refractory materials.	PO3, PO6, PO8, PO9, PO10, PO11	PSO1, PSO2, PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
CO1												3	2	
CO2	3											3	2	2
CO3		3	3									2		3
CO4		2			3								3	2
CO5		2	3			3				3	3		3	2
CO6			3			3		2	3	3	3	3	3	2

Correlation: 3-High, 2-Medium, 1-Low

Activities:

1.	Technical Poster on Industrial Furnaces and Their Applications in Metallurgical Industries
2.	Technical Seminar Presentation on Sustainable Fuel Utilization and Modern Furnace Technologies (Independent Study)

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (14–20)	Good (7–13)	Satisfactory (1–6)
1.	Technical Content	20	Comprehensive and technically accurate	Adequate coverage	Limited coverage
2.	Understanding of Metallurgical Concepts	20	Excellent understanding demonstrated	Good understanding	Basic understanding
3.	Organization and Presentation	20	Well-organized and logically structured	Adequately organized	Poor organization
4.	Visual Effectiveness	20	Clear and attractive presentation	Adequate visual presentation	Limited visual appeal
5.	Response to Questions	20	Accurate and confident responses	Adequate responses	Limited responses
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Technical Depth	20	In-depth understanding and analysis	Adequate technical depth	Limited technical depth
2.	Literature Survey	20	Comprehensive review of literature	Adequate review	Limited review
3.	Presentation Skills	20	Excellent communication and delivery	Good communication	Average communication
4.	Technical Discussion	20	Effective discussion with critical analysis	Adequate discussion	Limited discussion
5.	Report Quality	20	Professional quality report	Acceptable report	Poor documentation
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	12	12	-	-	12	2
CO2	24	24	-	-	24	3
CO3	16	16	-	-	16	2
CO4	8	8	-	-	8	1
CO5	-	-	40		25	3
CO6	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MT303	METALLURGICAL THERMODYNAMICS AND KINETICS		SEMESTER				III
Prerequisites		Category	ES(PC)	Credits			3
Engineering Chemistry & Engineering Mathematics		Hours/ Semester	L	T	P	SL	TH
			45	15	0	30	90
COURSE OBJECTIVES							
1.	To impart knowledge on the principles of thermodynamics applicable to metallurgical and materials engineering.						
2.	To develop the ability to analyse thermodynamic properties, phase equilibria and solution behavior in engineering materials.						
3.	To provide knowledge on thermodynamic potentials and their applications in metallurgical systems.						
4.	To familiarize students with electrochemical processes and reaction kinetics in metallurgical operations.						
5.	To develop analytical skills for solving engineering problems involving thermodynamics and kinetics						
UNIT – I							
CONCEPTS AND FIRST LAW OF THERMODYNAMICS		9					
Introduction: System and surrounding, Classification of systems, Path and state properties, Thermodynamic processes, Thermodynamic equilibrium, Reversible and Irreversible processes. First law of thermodynamics: Heat and work, Enthalpy, Internal energy, Heat capacity of materials, Cp-Cv relations, Nernst Equation, Thermochemistry: Hess's law and Kirchhoff's law. Maximum flame temperature – Basic problems on Hess's and Kirchhoff's law.							
UNIT - II		SECOND AND THIRD LAW OF THERMODYNAMICS					
		9					
Second law of thermodynamics: Carnot cycle, Entropy - Statistical interpretation of entropy, Free energy, Combined statement of first and second laws, Thermodynamic functions - Maxwell's relations, Gibbs - Helmholtz equation. Third and Zeroth laws of thermodynamics: Definition, concept and applications - Basic problems on second and third law of thermodynamics.							
UNIT-III		THERMODYNAMIC POTENTIALS AND PHASE EQUILIBRIA					
		9					
Thermodynamic potentials: Fugacity, Activity and Equilibrium constant. Clausius - Clapeyron equation, Trouton's rule. Le Chatelier's principle, Van't Hoff's equation. Equilibria in phase diagrams: Phase rule, Phase stability, Thermodynamics of surfaces, interfaces and defects, P-G-T diagrams, Application of free energy - composition diagrams to the study of alloy systems – Basic problems related to thermodynamic potentials.							
UNIT- IV		THERMODYNAMICS OF SOLUTIONS					
		9					
Gibbs - Duhem equation, Partial and integral molar quantities, chemical potential, Ideal solutions - Raoult's law, Real solutions, Activity coefficient, Henry's law, Alternative standard states, Sievert's law, Mixing functions and excess functions, Regular solutions, Applications of Gibbs - Duhem equation – Basic problems on solution thermodynamics.							
UNIT – V		ELECTROCHEMICAL PROCESS AND KINETICS					
		9					
Electrochemical process: Cells, Interconversion of free energy and electrical work, Determination of thermodynamic quantities using reversible cells, Solid electrolytic cells. Kinetics: First, Second and third order reactions, Arrhenius equation - activation energy, Determination of order of the reaction.							
L:45, T: 15, SL :30, Total:90 Hours							

Weightage:

Continuous Assessment 40%

End Semester Examinations 60%

TEXT BOOKS:

1.	Ahindra Ghosh, Textbook of Materials & Metallurgical Thermodynamics, Prentice Hall India, 2002
2.	Upadhyaya G S and Dube R K., "Problems in Metallurgical Thermodynamics & Kinetics", Pergamon, 1977.
3.	David R Gaskell, "Introduction to the Thermodynamics of Materials", Fifth Edition, Taylor & Francis, 2008

REFERENCE BOOKS:

1.	David V Ragone, "Thermodynamics of Materials - Volume-1", John Wiley & Sons, Inc. 1995.
2.	Dr S.K Dutta, Prof A.B. Lele – Metallurgical thermodynamics kinetics and numericals, S.Chand & co Ltd., New Delhi 2011
3.	Darken LS and Gurry R W, "Physical Chemistry of Metals", CBS publications and distributors, 2002.
4.	Parker R H, "An introduction to chemical metallurgy", Pergamon press, New York, second edition, 1978.
5.	Kapoor M.L., "Chemical and Metallurgical Thermodynamics Vol. I and II", Nem Chand, 1st Ed., 1981.

E-RESOURCES:

1.	www.nptelvideos.in/2012/12/basicthermodynamics.html
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COURSE OUTCOMES (COs) /**At the end of the course, the students will have the ability to**

		Mapping POs	Mapping PSOs
CO1	Apply the fundamental laws of thermodynamics, Maxwell's relations, solution concepts, and electrochemical concepts to solve quantitative numerical problems in materials processing.	PO1, PO2	PSO1, PSO2
CO2	Analyze the relationship between thermodynamic driving forces, phase equilibrium criteria, chemical potentials, and reaction kinetics in multicomponent metallurgical systems.	PO1, PO2, PO4	PSO1, PSO2
CO3	Analyze free energy-composition configurations, structural phase stability parameters, and solution behaviors using ideal, real, and regular solution thermodynamic frameworks.	PO1, PO2, PO3, PO4	PSO1, PSO2
CO4	Analyze variables governing thermochemical equilibria, electrochemical cell dynamics, reaction order mechanics, and activation energies across metallurgical transformations.	PO1, PO2, PO3, PO4	PSO1, PSO2
CO5	Evaluate thermodynamic processes, mixing properties, activity variations, and cell interconversions to judge the spontaneity and feasibility of complex metallurgical extraction systems.	PO1, PO2, PO3, PO4, PO11	PSO1, PSO2, PSO3
CO6	Formulate integrated thermodynamic and kinetic models utilizing reaction equations, phase rules, and temperature-dependent behavior functions to design stable, optimized alloy and electrochemical operations.	PO1, PO2, PO3, PO4, PO5, PO11	PSO1, PSO2, PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
CO1	3	3	0	0	0	0	0	0	0	0	0	0	3	2
CO2	3	3	0	2	0	0	0	0	0	0	0	0	3	2
CO3	3	3	2	2	0	0	0	0	0	0	0	0	3	3
CO4	3	3	2	2	0	0	0	0	0	0	0	0	3	3
CO5	3	3	2	2	0	0	0	0	0	0	0	1	2	2
CO6	3	3	0	0	0	0	0	0	0	0	0	0	3	2

Activities:

1.	Technical Poster on Applications of Thermodynamics and Kinetics in Metallurgical Processes
2.	Technical Seminar Presentation on Contemporary Applications of Metallurgical Thermodynamics and Kinetics (Independent Study)

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Application of Thermodynamic Principles	20	Accurate and comprehensive application	Minor errors	Limited application
2.	Evaluation of Phase Equilibria and Solution Behaviour	20	Correct interpretation with technical justification	Adequate evaluation	Weak analysis
3.	Electrochemical and Kinetic Assessment	20	Excellent engineering evaluation	Moderate assessment	Incomplete assessment
4.	Engineering Decision Making	20	Appropriate and justified conclusions	Reasonable conclusions	Poor justification
5.	Technical Report and Presentation	20	Professional documentation and presentation	Adequate presentation	Poor documentation
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Problem Formulation and Process Design	20	Technically sound and innovative solution	Adequate design	Incomplete design

2.	Integration of Thermodynamics and Kinetics	20	Excellent integration of concepts	Moderate integration	Limited integration
3.	Engineering Feasibility and Sustainability	20	Highly feasible and sustainable design	Reasonably feasible	Weak feasibility
4.	Technical Accuracy and Numerical Analysis	20	Accurate calculations and engineering interpretation	Minor calculation errors	Poor analysis
5.	Documentation and Presentation	20	Professional technical report and presentation	Adequate documentation	Poor documentation
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24	-	-	24	3
C03	16	16	-	-	16	2
C04	8	8	-	-	8	1
C05	-	-	40		25	3
C06	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26CE307	MECHANICS OF DEFORMABLE BODIES		SEMESTER				III	
PREREQUISITES			Category	ES(PC)	Credits			4
NIL			Hours/ Semester	L	T	P	SL	TH
				45	15	0	60	120
COURSE OBJECTIVES								
1.	To learn the fundamental concepts of stress, strain and their relations based on linear elasticity with applications to bars and beams.							
2.	Analyze the bending of various types of beams under static loading conditions and compute the shear-moment diagrams of a beam and find the Maximum moment/shear and their locations for different cross sections of beams.							
3.	Understand the basic concept of theory of flexure and torsion, springs and strain energy.							
4.	To learn the principles of mechanics applied to different materials under static conditions and to develop problem solving skills through application of these principles to basic engineering problems.							
5.	To learn the principles of mechanical behaviour of engineering materials, various tests under dynamics conditions and parametric studies.							
UNIT - I	SIMPLE STRESSES, BEHAVIOUR OF COMPOSITE SECTIONS, THERMAL STRESSES							9+3
Mechanical properties of solids –Hooke’s law, principle of superposition, Bars of varying sections –Elastic constants – composite sections – determination of stress, strain, deformation –Temperature stress, strain.								
UNIT - II	BENDING AND SHEAR							9+3
Types of beams – shear force and bending moment. Theory of simple bending - Analysis of stress-load carrying capacity. Shear stress distribution of simple beams of different cross sections								
UNIT - III	TORSION AND SPRINGS							9+3
Torsion of circular shaft – Hollow and solid circular section, torsional rigidity-stepped shaft-Twist and torsional stiffness, compound shaft-shafts springs-Stiffness and deflection of helical springs, leaf spring								
UNIT - IV	MECHANICAL BEHAVIOUR OF MATERIALS UNDER STATIC LOADS							9+3
Tension tests – stress – strain diagram, Elastic and plastic regions – True stress – strain properties in tension – fracture under tensile loads – compression and Torsion tests – stress concentration –Residual stresses								
UNIT - V	MECHANICAL BEHAVIOUR OF MATERIALS UNDER DYNAMIC LOADS							9+3
Fatigue loading and Fatigue fracture – Fatigue tests – Empirical relations between variable stress and mean stress – Fatigue stress concentration Factors – Cumulative Damage – Endurance limit –Impact – notched – Bar Impact tests, Charpy Impact tests – Izod Impact tests – Elevated temperature – Creep tests – Isochronous curves – stress Relaxation – Parametric methods								
L:45, T:15, SL:60, Total: 120 Hours								
Weightage:								
Continuous Assessment 40%								
End Semester Examinations 60%								

REFERENCE BOOKS:	
1.	Rajput. R.K., —Strength of Materials, S. Chand & Co, Delhi, Third Edition, 2003
2.	James M.Gere, Mechanics of Materials, Brooke/Cole Thomson Learning, 5 Ed., 2001.
3.	Dr.R.Vaithiyathan, Dr. P. Perumal & Lingeswari, Mechanics of Solids and Structures Volume-I Sci-tech publications, India (Pvt) Chennai-17.
4.	Srinath L.S; - Strength of materials – Macmillan India Limited – New Delhi,2017
5.	Timoshenko S.P., —Elements of Strength of Materials, Tata McGraw- Hill, New Delhi

E-RESOURCES:

1.	MIT Open Courseware https://ocw.mit.edu/courses/1-105-solid-mechanics-laboratory-fall-2003/
2.	YouTube https://www.youtube.com/watch?v=B9lyGZzb_6M&list=PLIhUrsYr8yHzft7ygw5THZo4aDcsxEadP

COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Analyze fundamental stress and strain in bars, beams, and shafts under static, thermal, and dynamic loads.	--	--
CO2	Evaluate material response-including elastic, plastic, and fatigue behavior-across composite sections, springs, and varying cross - sections.	PO1, PO2	PSO1, PSO2, PSO3
CO3	Calculate deformation and load-carrying capacity for components subject to tension, bending, torsion, and impact forces.	PO1, PO2	PSO1, PSO2, PSO3
CO4	Relate mechanical properties and constants to the performance of materials under environmental factors like temperature and cyclic loading.	PO1, PO6, PO7, PO11	PSO1, PSO2, PSO3
CO5	Interpret experimental data from tension, fatigue, and impact tests to predict failure in beams, shafts, and structural members.	PO2, PO4, PO5, PO8, PO9	PSO1, PSO2, PSO3
CO6	Apply principles of superposition and endurance limits to design resilient components against stress concentration and creep.	PO1, PO2, PO3, PO6, PO7, PO10	PSO1, PSO2, PSO3

The Course Articulation Matrix (CAM)for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO2	3	2	--	--	--	--	--	--	--	--	--	3	3	2
CO3	3	3	--	--	--	--	--	--	--	--	--	3	2	1
CO4	2	--	--	--	--	2	1	--	--	--	1	2	3	2
CO5	--	2	--	3	2	--	--	2	2	--	--	2	3	3
CO6	2	2	3	--	--	2	2	--	--	1	--	3	3	2

Activities:

1.	Virtual Lab Simulation (C05) Use a simulator to perform a tension test. Have students plot the data to identify the elastic vs. plastic regions and determine the modulus of resilience.
2.	Stepped Shaft Design (C06) Assign a problem where a shaft has multiple diameter changes. Students must apply stress concentration factors and use the principle of superposition to find the maximum allowable torque.

Rubrics for evaluation:C05

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Data Extraction	25	Precise derivation of properties from Tension, Fatigue, and Impact tests.	Accurate with minor errors in non-critical data processing.	Significant errors in interpreting raw test data.
2.	Failure Modelling	30	Comprehensive prediction of failure for beams and shafts.	Correct safety checks with minor oversights.	Fails to evaluate failure for critical components.
3.	Test Comparison	25	Advanced analysis of Charpy vs. Izod and Fatigue behavior.	Sound analysis with minor errors in comparison.	Poor understanding of different testing methods.
4.	Material Behavior	20	Flawless integration of true stress-strain and fracture limits.	Includes major properties but lacks specific depth.	Inadequate consideration of material limits.
	Total	100			

Rubrics for evaluation:C06

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Superposition Analysis	25	Precise calculation of combined loading using superposition.	Accurate with minor errors in loading combinations.	Significant errors in combining stress types.
2.	Fatigue Life Design	30	Flawless application of endurance limits and S-N curves.	Correct design with minor oversights in fatigue life.	Fails to calculate endurance limits correctly.
3.	Stress Concentration	25	Advanced analysis of stepped shafts and stress raisers.	Sound analysis with minor errors in factors.	Poor understanding of stress concentration.
4.	Creep & Reliability	20	Flawless integration of long-term creep and safety factors.	Includes major provisions but lacks specific depth.	Inadequate consideration of creep or safety.
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24	-	-	24	3
C03	16	16	-	-	16	2
C04	8	8	-	-	8	1
C05	-	-	40		25	3
C06	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%); Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MT304		MINERALS AND FUELS LABORATORY		SEMESTER			III		
Prerequisites				Category	ES(PC)	Credits			2
Engineering Chemistry				Hours/ Semester	L	T	P	SL	TH
					0	0	45	15	60
COURSE OBJECTIVES									
1.	To familiarize students with laboratory equipment used in mineral processing and fuel characterization.								
2.	To develop practical skills in the analysis of physical and chemical properties of minerals and fuels.								
3.	To perform experiments related to crushing, grinding, screening, sampling and mineral beneficiation.								
4.	To evaluate the engineering performance of mineral processing equipment through laboratory investigations.								
5.	To interpret experimental results for mineral beneficiation and fuel quality assessment								
List of Experiments									
1.	Determine the flash and fire points of the given oil sample.								
2.	Determine the viscosity of oil using the Redwood viscometer.								
3.	Determine the particle size distribution using sieve analysis.								
4.	Evaluate the screening efficiency of the given mineral sample.								
5.	Obtain a representative ore sample using standard sampling techniques.								
6.	Evaluate the performance characteristics of the laboratory jaw crusher.								
7.	Assess the grinding performance of the laboratory ball mill.								
8.	Determine the proximate composition of the given coal sample.								
9.	Determine the settling velocity of calcium carbonate particles experimentally.								
10.	Evaluate mineral separation using the froth flotation process								
P:45, SL :15, Total:60 Hours									
Weightage: Continuous Assessment 60% End Semester Examinations 40%									
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to					Mapping POs		Mapping PSOs		
CO1	Apply standard laboratory procedures to determine the physical properties of minerals and fuels using appropriate testing equipment.				PO5		PSO2		
CO2	Apply mineral processing techniques such as crushing, grinding, sampling and screening for ore beneficiation.				PO1, PO5		PSO1, PSO2		
CO3	Analyze the performance of mineral processing equipment and interpret experimental data related to particle size reduction and classification.				PO2, PO4		PSO1, PSO2		
CO4	Evaluate fuel quality and beneficiation efficiency using laboratory investigations and standard testing methods.				PO2, PO5		PSO1, PSO3		

C05	Evaluate mineral processing operations by correlating experimental observations with engineering principles and industrial practices.	PO2, PO4, PO6	PSO1, PSO3
C06	Create technical reports and recommend suitable mineral processing and fuel testing methodologies for industrial applications.	PO3, PO5, PO9	PSO2, PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
C01					3								3	
C02	3				3							2	2	
C03		3		3								2	2	
C04		3			3							2		2
C05		3		3		2						2		2
C06			3		3				3				2	2

Activities:

1.	Minerals and Fuels Poster Presentation
2.	Mineral Processing Technical Seminar

Rubrics for evaluation: C05

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Experimental Setup & Equipment Handling	20	Correct setup and efficient handling of laboratory equipment	Minor operational errors	Frequent operational errors
2.	Data Collection & Performance Analysis	20	Accurate data collection with comprehensive analysis	Minor analysis errors	Incomplete analysis
3.	Interpretation of Results	20	Excellent interpretation supported by engineering principles	Adequate interpretation	Limited interpretation
4.	Beneficiation/Fuel Quality Evaluation	20	Comprehensive evaluation with proper justification	Reasonable evaluation	Poor evaluation
5.	Laboratory Record & Viva-Voce	20	Excellent documentation and technical explanation	Good documentation	Incomplete documentation
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Problem Identification	20	Clearly identifies mineral processing/fuel testing problem	Adequate identification	Limited understanding
2.	Experimental Planning	20	Well-planned methodology with proper selection of experiments	Adequate planning	Poor planning
3.	Technical Analysis	20	Comprehensive engineering analysis and recommendations	Moderate analysis	Basic analysis
4.	Industrial Applicability	20	Highly relevant recommendations for industrial practice	Reasonably applicable	Limited applicability
5.	Technical Report & Presentation	20	Professional documentation and presentation	Good documentation	Basic documentation
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Laboratory Component		Percentage allocation	Mapping Strength
	Evaluation of Student Work, Observation of Record and Model Test	Activities		
CO1	20	20	20	2
CO2	20	20	20	2
CO3	20	20	20	2
CO4	20	20	20	2
CO5	10	10	10	2
CO6	10	10	10	2
Total	100	100	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);

Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26ENC03	PLACEMENT AND SOFT SKILLS LABORATORY B.E. (Common to all Branches)			SEMESTER		III		
Prerequisites			Category	HM	Credits		2	
1. Basic knowledge in reading skill and writing skill 2. Basic ability in listening skill and speaking skill			Hours/ Semester	L	T	P	SL	TH
				-	-	45	15	60
COURSEOBJECTIVES								
1.	To develop learners' overall employability communication skills in writing, speaking, verbal ability, and reasoning.							
2.	To strengthen learners' professional writing competence for letters, emails, resumes, and reports.							
3.	To enhance learners' oral communication and group interaction skills for presentations, discussions, and workplace contexts.							
4.	To build learners' soft skills, confidence, and interview readiness for successful career entry.							
5.	To improve learners' verbal and logical abilities to support effective communication and problem-solving							
UNIT-I		WRITING SKILLS						9
Letter seeking permission to go on industrial visit, Letter of invitation, Resume and cover letter, Job application, E-mail writing, Report writing - progress in project work								
UNIT-II		SPEAKING SKILLS						9
Welcome address and vote of thanks, Analysing and presenting business articles, Power point presentation, Presenting the visuals effectively, Group discussion, Participating in group discussions, Understanding group dynamics, Brain-storming the topics								
UNIT-III		SOFT SKILLS						9
Employability and career skills, Self-introduction, Introducing oneself to the audience, introducing the topic, Interview skills, Interview etiquette, Dress code, Body language, Attending job interviews								
UNIT-IV		VERBAL ABILITIES						9
Error Spotting, Listening Comprehension, Reading comprehension, Rearranging Jumbled sentences, Vocabulary								
UNIT-V		REASONING ABILITIES						9
Series completion, Analogy, Classification, Coding-Decoding, Blood relations, Seating Arrangements, Directional Sense, Venn Diagram, Logical reasoning, Statements and Conclusions								
P:45, SL:15, Total: 60 Hours								
Weightage: Continuous Assessment - 60% End Semester Examinations - 40%								

REFERENCE BOOKS:

1.	Pease, Allan, and Barbara Pease. The Definitive Book of Body Language. Bantam Books, 2017.
2.	Pillai, Sabeena, and Agna Fernandez. Soft Skills and Employability Skills. Cambridge University Press, 2018.
3.	Aggarwal, R. S. A Modern Approach to Verbal and Non-Verbal Reasoning. S. Chand Publishing, 2018.
4.	Mitra, Barun K. Personality Development and Soft Skills. Oxford University Press, 2016.
5.	Thorpe, Edgar, and Showick Thorpe. Winning at Interviews. Pearson Education, 2015.

E-RESOURCES:

1.	https://www.indiabix.com/
2.	https://www.placementpreparation.io/
3.	https://www.edx.org/
4.	https://www.cambridgeenglish.org/
5.	https://www.coursera.org/

COURSE OUTCOMES(COs)/**At the end of the course, the students will have the ability to****Mapping
POs****Mapping
PSOs**

CO1	Apply effective writing skills to produce professional documents such as letters, resumes, cover letters, emails, and project reports.	PO9, PO11	
CO2	Demonstrate oral communication skills by participating in presentations, group discussions, brainstorming sessions, and delivering structured talks using appropriate language and presentation techniques.	PO8, PO9, PO11	PSO3
CO3	Apply verbal ability skills to enhance language accuracy and comprehension through error spotting, vocabulary usage, reading comprehension, listening comprehension, and sentence rearrangement.	PO9, PO11	
CO4	Solve logical and analytical problems using reasoning abilities such as series completion, analogy, classification, coding-decoding, seating arrangements, blood relations, and data interpretation.	PO9, PO11	
CO5	Develop employability and workplace readiness skills by practicing self-introduction, interview techniques, interview etiquette, professional dress code, and body language.	PO9, PO11	
CO6	Integrate communication, analytical, and interpersonal skills to function effectively in academic and professional environments by demonstrating overall competence in written, spoken, verbal, and reasoning tasks.	PO9, PO10, PO11	PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1									3		2			
CO2								2	3		2			2
CO3									3		2			
CO4									3		2			
CO5									3		2			
CO6									3	2	2			2

Activities:

1.	CO1: Apply effective writing skills to produce professional documents such as letters, resumes, cover letters, emails, and project reports. (i) Cover Letter and Resume: Draft a resume and cover letter for a job advertisement (ii) Letter Writing: Write formal letter for an internship, industrial visit, workshop, or training programme; Write a letter to invite a chief guest, industry expert, or alumni for a college event. (iii) Email Writing: Write an email applying for an internship in a company; Send an email requesting registration for a workshop, seminar, or conference.
2.	CO2: Demonstrate oral communication skills by participating in presentations, group discussions, brainstorming sessions, and delivering structured talks using appropriate language and presentation techniques. (i) Self-Introduction: Professional self-introduction activity for placement preparation. (ii) Group Discussion: Group discussion on current social, technical, or business issues. (iii) Welcome Address, Vote of Thanks: Conduct a mock seminar where students deliver welcome addresses and vote of thanks. (iv) Power Point Presentation: Prepare and deliver a PowerPoint presentation on a technical, business, or general-interest topic using appropriate visual aids, effective slide design, and clear oral communication.
3.	CO3: Apply verbal ability skills to enhance language accuracy and comprehension through error spotting, vocabulary usage, reading comprehension, listening comprehension, and sentence rearrangement. (i) Jumbled Sentences: Sentence reconstruction activity to improve coherence and logical sequencing. (ii) Reading Comprehension: Analyze newspaper articles, business reports, or technical passages and answer comprehension questions. (iii) Error Spotting: Identify and correct errors related to tenses, articles, prepositions, and subject-verb agreement.

4.	CO4: Solve logical and analytical problems using reasoning abilities such as series completion, analogy, classification, coding-decoding, seating arrangements, blood relations, and data interpretation. (i) Series Completion: Pattern recognition and numerical reasoning exercises. (ii) Analogy: Verbal and logical analogy exercises. (iii) Coding-Decoding: Coding-decoding problem-solving exercises in teams (iv) Blood Relations: Family tree analysis and relationship mapping tasks. (v) Seating Arrangements: Puzzle-solving activities involving linear and circular arrangements. (vi) Logical Reasoning: Aptitude test simulations for placement preparation.
5.	CO5: Develop employability and workplace readiness skills by practicing self-introduction, interview techniques, interview etiquette, professional dress code, and body language. (i) Self-Introduction, Job Interview: Resume-based interview practice and feedback sessions; Mock interview sessions with HR and technical rounds; Professional etiquette workshop focusing on dress code, body language, and workplace behaviour.
6.	CO6: Integrate communication, analytical, and interpersonal skills to function effectively in academic and professional environments by demonstrating overall competence in written, spoken, verbal, and reasoning tasks. (i) Placement: Campus recruitment simulation involving aptitude test, group discussion, and personal interview. (ii) Presentation of Business Article: Team-based analysis and presentation of a business or technical article. (iii) Welcome Address, Vote of Thanks: Organize and manage a mock conference or seminar, assigning roles to students. (iv) Welcome Address, Vote of Thanks: Portfolio preparation documenting written tasks, presentations, interview performance, and reasoning exercises.

Rubrics for evaluation: CO1

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Content Relevance	5	Fully relevant content	Mostly relevant content	Limited relevance
2.	Organization and Format	5	Well-organized and correctly formatted	Minor organizational errors	Poor organization and format
3.	Professional Tone	5	Appropriate professional tone	Generally appropriate tone	Inappropriate tone
4.	Language Accuracy	5	Error-free language	Minor language errors	Frequent language errors
	Total	20			

Rubrics for evaluation: C02

Sl. No.	Criterion	Marks	Excellent(3)	Good(2)	Satisfactory(1)
1.	Clarity and Fluency	5	Clear and fluent speech	Minor hesitation	Frequent hesitation
2.	Content Organization	5	Well-structured presentation	Adequately organized	Poorly organized
3.	Presentation Skills	5	Excellent delivery and engagement	Adequate delivery	Limited engagement
4.	Body Language	5	Excellent posture, eye contact, and gestures	Adequate non-verbal communication	Poor posture and limited eye contact
	Total	20			

Rubrics for evaluation: C03

Sl. No.	Criterion	Marks	Excellent(3)	Good(2)	Satisfactory(1)
1.	Comprehension	5	Excellent understanding	Good understanding	Limited understanding
2.	Language Accuracy	5	Accurate error identification	Minor inaccuracies	Frequent inaccuracies
3.	Vocabulary Usage	5	Appropriate vocabulary usage	Adequate vocabulary usage	Limited vocabulary usage
4.	Logical Sequencing	5	Highly logical sequencing	Generally logical	Poor sequencing
	Total	20			

Rubrics for evaluation: C04

Sl. No.	Criterion	Marks	Excellent(3)	Good(2)	Satisfactory(1)
1.	Problem Analysis	5	Accurate problem analysis	Good analysis	Limited analysis
2.	Logical Reasoning	5	Strong reasoning ability	Adequate reasoning ability	Weak reasoning ability

3.	Accuracy	5	Highly accurate solutions	Adequate vocabulary usage	Limited vocabulary usage
4.	Time Management	5	Completes within time	Minor delay	Significant delay
	Total	20			

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent(3)	Good(2)	Satisfactory(1)
1.	Professional Etiquette	2.5	Highly professional behaviour	Generally professional	Limited professionalism
2.	Interview Skills	2.5	Confident and effective responses	Adequate responses	Weak responses
3.	Body Language	2.5	Excellent body language	Adequate body language	Poor body language
4.	Workplace Readiness	2.5	Highly workplace-ready	Reasonably prepared	Needs improvement
	Total	10			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent(3)	Good(2)	Satisfactory(1)
1.	Communication Skills	2.5	Highly effective communication	Effective communication	Limited effectiveness
2.	Analytical Skills	2.5	Strong analytical ability	Adequate analytical ability	Weak reasoning ability
3.	Teamwork Skills	2.5	Excellent teamwork and leadership	Good teamwork	Limited teamwork
4.	Professional Competence	2.5	Demonstrates overall competence	Demonstrates adequate competence	Requires improvement
	Total	10			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Laboratory Component		Percentage allocation	Mapping Strength
	Evaluation of Student Work, Observation of Record and Model Test	Activities		
CO1	20	20	20	2
CO2	20	20	20	2
CO3	20	20	20	2
CO4	20	20	20	2
CO5	10	10	10	2
CO6	10	10	10	2
Total	100	100	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MCC03	UNIVERSAL HUMAN VALUES B.E. (Common to All Branches)		SEMESTER				III
Prerequisites		Category	MC	Credits			3
Basic awareness of human values, personal behaviour, family relationships, social responsibility, and ethical conduct in daily life. Familiarity with the ideas of self-reflection, harmony, happiness, prosperity, and responsible living will be helpful.		Hours/ Semester	L	T	P	SL	TH
			45	-	-	45	90
COURSE OBJECTIVES							
1.	To understand the need, purpose, basic guidelines, content, and process of value education through self-exploration and natural acceptance.						
2.	To develop awareness of continuous happiness, prosperity, right understanding, relationship, and physical facility as the basic human aspirations.						
3.	To understand harmony in the human being by studying the co-existence of the sentient 'I' and the material 'Body', along with Sanyam, health, and prosperity.						
4.	To understand harmony in family and society through human relationships, trust, respect, justice, fearlessness, prosperity, and universal harmonious order.						
5.	To realize harmony in nature and existence and apply holistic understanding of human values to professional ethics, ethical human conduct, sustainable development, and responsible professional practice.						
UNIT - I		Introduction to Universal Human Values and Human Aspirations					
Course Introduction - Need, Basic Guidelines, Content and Process for Value Education. Purpose and motivation for the course, recapitulation from Universal Human Values-I. Self-Exploration-what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario Method to fulfil the above human aspirations- understanding and living in harmony at various levels.							
UNIT - II		Harmony in the Human Being: Self and Body					
Understanding Harmony in the Human Being - Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body' Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding the characteristics and activities of 'I' and harmony in 'I' Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Health.							
UNIT - III		Harmony in Family and Society: Human Relationships and Social Order					
Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship Understanding values in 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. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society Undivided Society, Universal Order- from family to world family.							

UNIT - IV		Harmony in Nature and Existence		
Understanding Harmony in the Nature and Existence - Whole existence as Coexistence. Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.				
UNIT - V		Professional Ethics and Universal Human Order		
Implications of the above Holistic Understanding of Harmony on Professional Ethics. Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics, Strategy for transition from the present state to Universal Human Order.				
L:45, SL :45, Total:90 Hours				
Weightage: Continuous Assessment: 40% End Semester Examinations: 60%				
REFERENCE BOOKS:				
1.	"Human Values and Professional Ethics", R R Gaur., R Sangal., G P Bagaria, Excel Books, New Delhi, 2010			
2.	"Human Values", A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.			
3.	"The Story of Stuff"., Annie Leonard, 2007 documentary.			
4.	"The Story of My Experiments with Truth"., Mohandas Karamchand Gandhi			
5.	"Small is Beautiful" - E. F Schumacher.			
E-RESOURCES:				
1.	AICTE, "Universal Human Values," All India Council for Technical Education, https://www.aicte.gov.in/bureaus/universal-human-values-cell			
2.	UHV Foundation, "Universal Human Values and Professional Ethics," https://uhv.org.in			
3.	Value Education Cell, "Universal Human Values Resources," https://fdp-si.aicte-india.org			
4.	SWAYAM, "Human Values and Professional Ethics," Ministry of Education, Government of India, https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg125			
5.	Universal Human Values Foundation https://uhv.org.in/			
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Remember and understand the basic concepts, purpose, need, process, and guidelines of value education, including self-exploration, natural acceptance, continuous happiness, prosperity, right understanding, relationship, and physical facility.		--	--
CO2	Apply the principles of self-exploration, natural acceptance, right understanding, relationship, and physical facility to assess human aspirations and improve harmony in personal life.		PO6	--

C03	Analyse harmony in the human being by understanding the coexistence of the sentient 'I' and the material 'Body', the needs of self and body, Sanyam, health, and prosperity.	PO7	--
C04	Examine harmony in family and society by understanding values in human relationships, justice, trust, respect, fearlessness, prosperity, co-existence, and universal harmonious order.	PO8	--
C05	Evaluate harmony in nature and existence by understanding interconnectedness, mutual fulfilment, recyclability, self-regulation, and holistic perception of coexistence at all levels.	PO6	--
C06	Integrate holistic understanding of human values, harmony, and ethical conduct to professional practice by considering societal needs, responsible decision-making, and sustainable human development.	PO11	--

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
C01														
C02						2								
C03							2							
C04								1						
C05						3								
C06											3			
Avg						2.5	2	1			3			

Activities:

1.	Students shall prepare a short reflective assignment on harmony in nature, interconnectedness, mutual fulfilment, recyclability, self-regulation, and coexistence at different levels of existence. This activity helps students understand the importance of sustainable living and holistic harmony.
2.	Students shall analyse a real-life case study related to professional ethics, responsible decision-making, societal needs, or sustainable human development. This activity develops the ability to apply human values, ethical conduct, and holistic understanding in professional and social life.

Rubrics for evaluation:C05

Sl. No.	Criterion	Marks	Excellent (9-10)	Good (6-8)	Satisfactory (1-5)
1.	Understanding harmony in nature	10	Clearly explains harmony, interconnectedness, and mutual fulfilment in nature	Explains the concept with minor gaps	Shows limited understanding
2.	Reflection on coexistence	10	Provides meaningful reflection on coexistence, recyclability, and self-regulation	Reflection is relevant but needs more depth	Reflection is basic or unclear

3.	Practical relevance	10	Relates harmony in nature to sustainable living and human responsibility effectively	Relates the concept with limited examples	Practical relevance is weak
4.	Presentation of assignment	10	Assignment is well-organized, clear, and neatly presented	Assignment is organized but needs improvement	Assignment is incomplete or poorly presented
	Total	40			

Rubrics for evaluation:CO6

Sl. No.	Criterion	Marks	Excellent (9-10)	Good (6-8)	Satisfactory (1-5)
1.	Selection of ethical case study	10	Suitable case study is selected with clear ethical relevance	Case study is relevant but needs minor clarity	Case study selection is basic or unclear
2.	Application of human values	10	Human values and ethical principles are applied effectively	Values are applied with minor gaps	Application of values is weak
3.	Responsible decision-making	10	Provides clear, responsible, and sustainable decision-making approach	Decision-making is acceptable but needs improvement	Decision-making is unclear or incomplete
4.	Report writing and conclusion	10	Report is well-structured with clear conclusion	Report is organized but needs improvement	Report is incomplete or poorly structured
	Total	40			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	12	12			12	2
CO2	24	24			24	3
CO3	12	12			12	2
CO4	12	12			12	2
CO5			40		20	2
CO6				40	20	2
Total	60	60	40	40	100	

Note:Purely as anExample: Strength = 3 (if percentage >20%);
Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26CY401	NON METALLIC MATERIALS		SEMESTER				IV
Prerequisites		Category	BS	Credits			3
Basic Chemistry		Hours/ Semester	L	T	P	SL	TH
			45	-	-	45	90
COURSE OBJECTIVES							
1.	To understand the fundamental concepts, nomenclature, classification, structure, polymerization mechanisms, molecular characteristics, and thermal behaviour of polymers.						
2.	To acquire knowledge of the physical, mechanical, thermal, electrical, optical, chemical and biological properties of polymers and understand the principles of polymer processing and recycling.						
3.	To understand the structure, bonding, properties, preparation, processing and applications of conventional and advanced ceramics and different types of glasses.						
4.	To develop an understanding of composite materials, particularly fiber-reinforced composites, their constituents, rule of mixtures, manufacturing techniques, properties and engineering applications.						
5.	To analyse particulate and laminar composites with respect to load transfer, failure mechanisms, manufacturing techniques and applications, and to develop self-learning skills through case studies and activity-based investigations.						
UNIT - I		INTRODUCTION TO POLYMERS:					9
Definition – nomenclature of polymers – classification of polymers based on source, structure, methods of synthesis, growth of polymer chain and molecular forces – polymerization types – mechanisms – degree of polymerization – molecular mass of a polymer – number-average and weight-average molecular mass – polydispersity index (PDI) – glass transition temperature and melting temperature – additives for polymers – process aids, antidegradants, fillers, curing agents and coupling agents – special additives.							
Activities:							
1. Identification and classification of commonly used polymers based on source, structure and applications.							
2. Calculation of degree of polymerization and PDI.							
UNIT - II		POLYMER PROPERTIES AND PROCESSING:					9
Polymer properties – physical, mechanical, chemical, thermal, electrical, optical, magnetic, and biological properties – Processing types – melt, rubbery stage, solution, emulsion, and suspension processing – Behaviour of polymers – viscoelasticity – creep and stress relaxation in polymers- yielding and fracture of polymers – crazing of polymers – recycling of polymers – Application of polymers in various fields (agriculture, space, automobile, electronics, medicine , construction and transport).							
Activities:							
1. Comparative study of the properties of selected thermoplastics, thermosetting polymers and elastomers.							
2. Preparation of a polymer processing and recycling flow chart for a selected polymer product.							
UNIT - III		CERAMICS:					9
Introduction – important properties – typical example of conventional and advanced ceramics – comparison with metals and polymers – ceramic bonding and crystal structure – crystal defects in ceramics – preparation, properties and uses of Boron nitride, Silicon carbide, Boron carbide, SiALON – Glass – types, properties, and applications of various types of glasses – manufacturing of glass (Blowing, pressing, drawing, rolling and casting)							
Activities:							
1. Identification and documentation of ceramic materials used in the home, with reference to their types and uses.							
2. Survey and comparative study of different types of glass materials used in various laboratories of the institution, based on their characteristics and applications. .							

UNIT - IV		FIBER COMPOSITES:		9
Composites – introduction – classification – eexamples – Fiber composites– constituents and functions of fiber composites – rule of mixtures – types of fibers and matrices – production techniques (in brief) for fiber composites – use of fiber composites in automobile, aerospace, sports and leisure applications.				
Activity: Comparative study of different types of fiber composite materials used in daily-use products, automobiles, buildings, sports equipment and other products in the home or nearby locality.				
UNIT - V		PARTICULATE AND LAMINAR COMPOSITES:		9
Particulate and Dispersion strengthened composites – load transfer mechanisms – factor influencing load transfer – failure mechanism - production techniques – applications – dispersoids – inter particle spacing – examples of particulate composites – Laminar composites – types layered and honeycomb structures – load transfer mechanisms – factor influencing load transfer – failure mechanism–manufacture methods and applications.				
Activity: Explore and categorize particulate and laminar composite materials found in daily-use products, household items, buildings and other commonly used products in the home or nearby locality.				
L:45, SL :45, Total:90 Hours				
Weightage: Continuous Assessment 40% End Semester Examinations 60%				
REFERENCE BOOKS:				
1.	Polymer Science – V.R.Gowarikar – New age international Pvt Ltd., 2015.			
2.	Fundamentals of Polymers – Niranjan karak – PHI learning Private Ltd., 2009.			
3.	Ceramic Materials-Science and Engineering - C. Barry Carter, M. Grant Norton, C. Barry Carter, M. Grant Norton – Springer Newyork- 2013.			
4.	Composite Materials: Engineering and Science books - F. L. Matthews, Rees D. Rawlings 1999.			
5.	Introduction to composite materials design - Ever J. Barbero, second edition.			
E-RESOURCES:				
1.	www.ePathshala.nic.in			
2.	www.onlinecourses.nptel.ac.in/			
3.	eGyanKosh – IGNOU Repository (http://egyankosh.ac.in)			
4.	https://www.unep.org			
5.	MIT OpenCourseWare (https://ocw.mit.edu)			
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Explain the fundamental concepts, classification, structure, properties, processing and applications of polymers, ceramics and composite materials.		---	---

CO2	Apply the principles of structure–property relationships, processing and material performance to select suitable polymers, ceramics and composite materials for specific engineering applications.	PO1	---
CO3	Analyze the relationships among material structure, properties, processing methods, defects, deformation and failure mechanisms of polymers, ceramics and composite materials for engineering applications.	PO2	---
CO4	Assess the suitability of polymers, ceramics and composite materials based on their properties, processing requirements, performance and specific engineering application needs.	PO6, PO8	---
CO5	Perform material identification, comparative studies, calculations, observations and activity-based investigations related to polymers, ceramics and composites, and interpret the findings using appropriate scientific principles.	PO8	---
CO6	Engage in self-learning activities related to advanced polymers, high-performance ceramics, fiber reinforced composites, particulate and laminar composites, sustainable materials and emerging engineering applications, and communicate the findings effectively.	PO8, PO9, PO11	

The Course Articulation Matrix (CAM) for defined COs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1														
CO2	3													
CO3		3												
CO4						2		2						
CO5								2						
CO6								2	2		2			

Activities:

1.	Conduct field-based, or activity-oriented studies related to polymer identification, polymer properties, polymer processing, ceramics, glass, fiber composites, particulate composites and laminar composites, and prepare reports based on observations, data, analysis and engineering applications. (CO5) (Individual and Collaborative Team Work)
2.	i) Conduct a comprehensive material selection/case study on polymers, ceramics or composites considering material properties, engineering performance, manufacturing requirements, environmental impact, sustainability, cost and application suitability. (CO4) (Individual and Collaborative Team Work) ii) Participate in self-learning activities such as seminars, case studies, quizzes, presentations and literature reviews on advanced polymers, nanocomposites, high-performance ceramics, smart polymers, carbon-fiber composites, sustainable composites, polymer recycling, additive manufacturing and emerging material technologies. (CO6) (Independent study)

Rubrics for evaluation:CO4

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Material Selection and Engineering Suitability	10	Comprehensive selection of suitable materials with strong technical justification based on properties and application requirements.	Appropriate material selection with adequate justification.	Limited material selection with insufficient justification.
2.	Property and Performance Analysis	5	Thorough comparison of mechanical, thermal, chemical and other relevant properties with clear interpretation.	Adequate comparison of major properties.	Limited comparison and interpretation.
3.	Manufacturing/Application Analysis	5	Clearly evaluates manufacturing method, processing requirements, performance and engineering application.	Addresses major manufacturing and application aspects with minor gaps.	Limited or incomplete analysis of manufacturing/application.
	Total	20			

Rubrics for evaluation:CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Understanding of Material Concepts	10	Demonstrates thorough understanding and accurate interpretation of polymer, ceramic and composite concepts.	Good understanding with minor gaps.	
2.	Data Collection and Observation	10	Accurate, systematic and comprehensive observations/data collection.	Mostly accurate observations and data collection.	Adequate but incomplete observations.
3.	Analysis and Interpretation	10	Excellent scientific analysis, comparison and interpretation of observations/data.	Good analysis with minor errors.	Basic analysis with limited interpretation.
4.	Report/Presentation Quality	10	Clear, well-organized, technically sound and professional report/presentation.	Well organized with minor issues.	Moderately organized with several deficiencies.
	Total	40			

Rubrics for evaluation:CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Conceptual Clarity	10	Demonstrates complete understanding and excellent clarity of the selected topic.	Demonstrates good understanding.	Demonstrates moderate/basic understanding.
2.	Accuracy of Content	5	Content is scientifically accurate, current and comprehensive.	Content is mostly accurate with minor gaps.	Content contains some inaccuracies or omissions.
3.	Participation and Preparedness	5	Highly engaged, well prepared and effectively communicates the topic.	Well prepared and participates adequately.	Partially prepared with limited participation.
	Total	20			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	12	12			12	2
CO2	24	24			24	3
CO3	24	24			24	3
CO4				20	10	2
CO5			40		20	2
CO6				20	10	2
Total	60	60	40	40	100	

Note:Purely as anExample: Strength = 3 (if percentage >20%);

Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MT401	MECHANICAL BEHAVIOUR AND TESTING OF MATERIALS				SEMESTER				IV	
Prerequisites					Category	ES(PC)	Credits			3
Engineering Physics					Hours/ Semester	L	T	P	SL	TH
						45	0	0	45	90
COURSE OBJECTIVES										
1.	To understand the fundamentals of elastic and plastic deformation mechanisms in engineering materials.									
2.	To acquire knowledge of tensile behaviour and various mechanical testing methods used for evaluating material properties.									
3.	To study hardness and impact testing techniques and their significance in material characterization.									
4.	To understand the principles of fracture and fracture mechanics in engineering materials.									
5.	To analyze fatigue and creep behaviour and their influence on the performance of materials under service conditions.									
UNIT - I		ELASTIC AND PLASTIC BEHAVIOUR								9
Elastic behaviour of Materials – Hooke’ Law – Dislocation, definition, types – Burger’s vector - Plastic deformation – Dislocation motion – Cross slip and climb – Slip and Twinning – Critical Resolved Shear stress. Stacking Faults – Deformation bands and Kink bands - Intersection of Dislocation – Jogs - Dislocation multiplication – Dislocation pile up. Strain hardening and Recovery – Dynamic strain aging.										
UNIT - II		TENSILE BEHAVIOUR AND TESTS								9
Introduction: Types of testing, Introduction to material properties (structure sensitive and insensitive), ASTM testing standards. Engineering stress and strain, True stress - strain curves, Relationship between the tensile properties, Hollomon Ludwig equation, Plastic Instability (Necking), Hot tensile tests, Testing machines – types, Testing procedures, specimen dimensions, Notch tensile test, Anisotropy of tensile properties. Bend test, torsion test & shearing test.										
UNIT- III		HARDNESS TESTS AND IMPACT TESTS								9
Definition, Types of hardness tests- Vickers, Brinell, Rockwell and Rockwell superficial hardness tests, Precautions - Relative merits and demerits, Hardness conversion, Rebound hardness test, Microhardness tests - Vickers and Knoop hardness tests, Concept of nano indentation. Izod and Charpy Impact tests, Instrumented Charpy test, Drop-weight Test and other large scale tests.										
UNIT- IV		FRACTURE AND FRACTURE MECHANICS								9
Types of fracture – ductile and brittle fracture, Ductile to Brittle Transition Temperature (DBTT), Metallurgical factors affecting DBTT, determination of DBTT, Theoretical cohesive strength of metals, Griffith’s theory of brittle fracture, Orowan’s modification. Stages in Ductile Fracture (Cup and Cone). Fracture mechanics-introduction, modes of fracture, stress intensity factor, strain energy release rate, fracture toughness and determination of K_{IC} , Introduction to COD.										
UNIT - V		FATIGUE AND CREEP BEHAVIOUR								9
Fatigue: Stress cycles, S-N curves, effect of mean stress, factors affecting fatigue, structural changes accompanying fatigue, cumulative damage, low cycle fatigue, Fatigue crack propagation. Creep: Creep curve, stages in creep curve and explanation, structural changes during creep, creep mechanisms, metallurgical factors affecting creep, high temperature alloys, stress rupture testing, Parameter methods of extrapolation – Larson Miller parameter, Creep-Fatigue interaction.										
L:45, SL :45, Total:90 Hours										

Weightage:

Continuous Assessment 40%

End Semester Examinations 60%

REFERENCE BOOKS:

1.	Dieter, G.E., Mechanical Metallurgy, 3rd SI Edition , McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2013.
2.	Reed-Hill, R.E. and Abbaschian, R., <i>Physical Metallurgy Principles</i> , 4th Edition , Cengage Learning, Stamford, USA, 2009.
3.	Courtney, T.H., <i>Mechanical Behaviour of Materials</i> , 2nd Edition , Waveland Press Inc., Illinois, USA, 2005.
4.	Honeycombe, R.W.K. and Bhadeshia, H.K.D.H., <i>Steels: Microstructure and Properties</i> , 4th Edition , Butterworth-Heinemann, Oxford, 2017.
5.	Wulff, J., et al., <i>The Structure and Properties of Materials, Volume III: Mechanical Behaviour of Materials</i> , Reprint Edition , Wiley Eastern Ltd., New Delhi, 2017.
6.	Davis, H.E., Troxell, G.E. and Hauck, G.E.W., <i>The Testing of Engineering Materials</i> , 4th Edition (Reprint) , McGraw-Hill Book Company, New York, 1982.

E-RESOURCES:

1.	https://ocw.mit.edu/courses/3-032-mechanical-behaviour-of-materials-fall-2007/
2.	http://www.digimat.in/nptel/courses/video/113104104/L17.html
3.	https://mrcet.com/downloads/digital_notes/ME/II%20year/Metallurgy%20&%20Material%20Science.pdf

COURSE OUTCOMES (COs) /**At the end of the course, the students will have the ability to****Mapping
POs****Mapping
PSOs**

CO1	Recall the fundamental concepts of deformation behaviour, mechanical testing methods, hardness, fracture, fatigue, and creep properties of engineering materials.	---	PSO1, PSO2
CO2	Apply the principles of deformation, mechanical testing, hardness measurement, fracture analysis, and creep-fatigue behaviour in materials engineering applications.	PO1, PO2	PSO1, PSO2
CO3	Analyze the mechanical behaviour of materials through tensile, hardness, impact, fracture, fatigue, and creep testing under different service conditions.	PO2, PO3, PO5	PSO1, PSO3
CO4	Analyze the influence of microstructure, deformation mechanisms, loading conditions, and environmental factors on the mechanical performance of materials.	PO2, PO5	PSO2, PSO3
CO5	Evaluate the suitability of materials based on their deformation characteristics, testing results, fracture resistance, fatigue life, and creep strength for engineering applications.	PO2, PO3, PO10	PSO2, PSO3
CO6	Develop appropriate material selection and performance assessment strategies using mechanical behaviour, testing data, fracture mechanics, fatigue, and creep characteristics.	PO3, PO6, PO8, PO9, PO10, PO11	PSO1, PSO2, PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
CO1												2	2	
CO2	3	2										3	2	
CO3		3	3		2							2		3
CO4		2			3								3	2
CO5		2	3							3			3	2
CO6			3			3		2	3	3	3	3	2	2

Activities:

1.	Technical Poster on Mechanical Testing Methods and Material Behaviour
2.	Technical Seminar Presentation on Failure Analysis and Material Performance in Engineering Applications (Independent Study)

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Technical Content	20	Comprehensive and technically accurate	Adequate coverage	Limited coverage
2.	Understanding of Metallurgical Concepts	20	Excellent understanding demonstrated	Good understanding	Basic understanding
3.	Organization and Presentation	20	Well-organized and logically structured	Adequately organized	Poor organization
4.	Visual Effectiveness	20	Clear and attractive presentation	Adequate visual presentation	Limited visual appeal
5.	Response to Questions	20	Accurate and confident responses	Adequate responses	Limited responses
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Technical Depth	20	In-depth understanding and analysis	Adequate technical depth	Limited technical depth
2.	Literature Survey	20	Comprehensive review of literature	Adequate review	Limited review
3.	Presentation Skills	20	Excellent communication and delivery	Good communication	Average communication

4.	Technical Discussion	20	Effective discussion with critical analysis	Adequate discussion	Limited discussion
5.	Report Quality	20	Professional quality report	Acceptable report	Poor documentation
	Total	100			

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The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	12	12	-	-	12	2
CO2	24	24	-	-	24	3
CO3	16	16	-	-	16	2
CO4	8	8	-	-	8	1
CO5	-	-	40		25	3
CO6	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MT402	PHYSICAL METALLURGY – II	SEMESTER				IV	
Prerequisites		Category	ES(PC)	Credits		3	
Elements of Physical Metallurgy		Hours/ Semester	L	T	P	SL	TH
			45	0	0	45	90
COURSE OBJECTIVES							
1.	Familiar with a generalized scheme of phase transformations important in metals and alloys.						
2.	Qualitative and quantitative description of thermodynamic and kinetics of phase transformations,						
3.	Apply their fundamental knowledge in order to describe important phase transformation and to deduce properties of metals and alloys						
4.	Understand shear-driven, diffusion less transformations such as martensitic transformations.						
5.	Understand the various strengthening mechanisms						
UNIT – I		SOLIDIFICATIONS					9
Driving force for solidification, Alloy solidification – Single phase binary alloy solidification, Cellular and dendritic solidification, constitutional super cooling, eutectic solidification, Solidification during quenching from melt, Concept of Activation energy and Arrhenius equation, Simple problems in above topics.							
UNIT - II		TRANSFORMATION KINETICS					9
Nucleation - Types of nucleation; Homogeneous nucleation - critical nucleus size, critical free energy change and nucleation rate; Heterogeneous nucleation - critical nucleus size, critical free energy change and nucleation rate; Rate of Heterogeneous nucleation, Growth Kinetics, Interface-Controlled growth, Diffusion-Controlled growth, Overall Transformation Kinetics – Empirical equations.							
UNIT- III		DIFFUSIONAL TRANSFORMATION					9
Diffusional transformation in solid; Homogeneous and heterogeneous nucleation in solids; Transformation kinetics for interface controlled growth and diffusion controlled growth, Johnson-Mehl-Avrami equation, simple numerical problems, Pearlitic Transformation, Experimental characteristics, Mechanism and kinetics of growth, Eutectoid transformation – nucleation and growth of pearlite, Interlamellar spacing, Bainite transformation; Spinodal decomposition - uphill diffusion, examples from metallic systems; Order-Disorder transformations; Precipitation.							
UNIT- IV		DIFFUSION LESS TRANSFORMATION					9
Massive transformations; Martensite transformation – Definition, Characteristic features of martensitic transformation in steels; Morphology of martensite - lath and plate martensite; Crystallography of martensitic transformation; Kinetic characteristics of martensitic transformation; Martensite in Non-Ferrous systems; Thermo elastic Martensite; Shape Memory effect - Examples and applications of shape memory alloys. Particle coarsening – Driving force and kinetics of coarsening							
UNIT – V		STRENGTHENING MECHANISMS					9
Work/Strain hardening: Grain Size & boundary strengthening, Solid Solution strengthening, Yield point Phenomena, Strain ageing, Precipitation Hardening – Conditions for Precipitation hardening and ageing, Formation of precipitates, Coarsening of precipitates. Mechanisms of strengthening – Dispersion Strengthening, Fiber strengthening, Martensite Strengthening. Examples for above strengthening Mechanisms from ferrous and nonferrous systems. Recovery, recrystallization and grain growth mechanisms							
L:45, SL :45, Total:90 Hours							

Weightage:

Continuous Assessment 40%

End Semester Examinations 60%

REFERENCE BOOKS:

1.	Raghavan, V. "Solid State Phase Transformations", Prentice - Hall of India, New Delhi, 2004.
2.	Porter, D.A. and Easterling, K.E., "Phase Transformations in Metals and Alloys", 2nd ed., Chapman and Hall, London 1992.
3.	Romesh C. Sharma, "Phase transformation in Materials", CBS Publishers & Distributors, New Delhi, 2011.
4.	Reed Hill, R.E., "Physical Metallurgy Principles", Affiliated East West Press, New Delhi, 1992.
5.	R. E. Smallman A.H.W. Ngan, "Modern Physical Metallurgy", Butterworth-Heinemann publication, 8th Edition, 2013.

E-RESOURCES:

1.	www.doitpoms.ac.uk
2.	https://nptel.ac.in/courses/112104220
3.	https://www.library.cbit.ac.in/OpenAccess-Courseware.htm
4.	http://www.digimat.in/cgi-bin/search.cgi
5.	www.matter.org / https://phet.colorado.edu/en/simulations/diffusion

COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Explain the thermodynamic principles governing solidification, nucleation, growth, and phase transformations in metallic materials, including the role of driving force, activation energy, and transformation kinetics.	--	
CO2	Apply solidification phenomena in pure metals and alloys, including nucleation, cellular and dendritic growth, constitutional supercooling, eutectic solidification, and microstructural evolution during cooling and quenching processes.	PO1	
CO3	Analyze nucleation and growth in solids and liquids to evaluate homogeneous and heterogeneous transformations, determine critical nucleation parameters, and assess transformation kinetics using empirical and mathematical models	PO2, PO3	
CO4	Analyze the phase transformations in diffusion and diffusion less transitions and various strengthening mechanisms	PO5	
CO5	Study torsional analysis of various components such as shafts, pressure vessels and springs through self-learning activities and present the findings while considering societal and economic impacts.	PO6, PO9, PO10, PO11	
CO6	Study torsional analysis of various components such as shafts, pressure vessels and springs through self-learning activities and present the findings while considering societal and economic impacts.	PO6, PO9, PO10, PO11	

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
CO1	3	2											3	
CO2	3	2			2							3	2	
CO3		3	2	3								2	2	
CO4		3	2	3	2								3	
CO5		2	3		3		2						2	3
CO6	3		3		3		2		2	2	2	2	3	3

Activities:

1.	Technical Poster on Phase Transformations and Microstructural Evolution in Metallic Materials
2.	Technical Seminar Presentation on Advanced Strengthening Mechanisms and Transformation Behaviour in Engineering Materials (Independent Study)

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (14–20)	Good (7–13)	Satisfactory (1–6)
1.	Technical Content	20	Comprehensive and technically accurate	Adequate coverage	Limited coverage
2.	Understanding of Metallurgical Concepts	20	Excellent understanding demonstrated	Good understanding	Basic understanding
3.	Organization and Presentation	20	Well-organized and logically structured	Adequately organized	Poor organization
4.	Visual Effectiveness	20	Clear and attractive presentation	Adequate visual presentation	Limited visual appeal
5.	Response to Questions	20	Accurate and confident responses	Adequate responses	Limited responses
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Technical Depth	20	In-depth understanding and analysis	Adequate technical depth	Limited technical depth
2.	Literature Survey	20	Comprehensive review of literature	Adequate review	Limited review
3.	Presentation Skills	20	Excellent communication and delivery	Good communication	Average communication
4.	Technical Discussion	20	Effective discussion with critical analysis	Adequate discussion	Limited discussion
5.	Report Quality	20	Professional quality report	Acceptable report	Poor documentation
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24	-	-	24	3
C03	16	16	-	-	16	2
C04	8	8	-	-	8	1
C05	-	-	40		25	3
C06	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MT403	HEAT TREATMENT TECHNOLOGY		SEMESTER				IV	
Prerequisites			Category	ES(PC)	Credits		3	
Elements of Physical Metallurgy, Mineral Dressing, Fuels and Furnaces			Hours/ Semester	L	T	P	SL	TH
				45	0	0	45	90
COURSE OBJECTIVES								
1.	To apply phase transformation principles for selecting suitable heat treatment processes.							
2.	To analyze the influence of heat treatment parameters on microstructure and mechanical properties.							
3.	To evaluate case hardening methods and heat treatment equipment for engineering applications.							
4.	To develop the ability to select appropriate heat treatment cycles for ferrous and non-ferrous alloys.							
5.	To create suitable heat treatment procedures to achieve desired engineering properties with minimum defects							
UNIT – I		TRANSFORMATIONS IN STEELS						9
Iron-carbon equilibrium diagram: Transformations on heating and cooling, Lever rule, influence of alloying elements-Ferrite Stabilizers, Austenite Stabilizers. General principles of heat treatment of steels. Isothermal and Continuous Cooling Transformations – Construction of TTT diagram and CCT diagrams.								
UNIT - II		HEAT TREATMENT PROCESSES						9
Annealing—types, Normalizing, Hardening, Factors affecting hardening. Tempering -Hollomon-Jaffe parameter, Retained Austenite, Subzero treatment. Hardenability- Jominy End Quench Test, Grossman's experiments, Temper Embrittlement. Austempering, Martempering, Thermo Mechanical Treatment of steels.								
UNIT- III		CASE HARDENING						9
Carburising-Types, Post carburizing techniques. Application of Fick’s law, Depth of carburizing, Cyaniding, Carbonitriding, Nitriding, Ion nitriding, Nitrocarburising, Flame hardening, Induction hardening, Electron beam hardening, Laser beam hardening. Case depth measurement.								
UNIT- IV		HEAT TREATMENT EQUIPMENT						9
Heating media, Temperature control, Atmosphere control, Carburising atmosphere, Carbon potential measurement, Nitriding atmosphere, Quenching media- Characteristics and Types. Heat treatment furnaces- Types, Fluidized bed furnace, Cryogenic treatment, Sealed quench furnace.								
UNIT – V		HEAT TREATMENT OF SPECIFIC ALLOYS						9
Heat treatment of Carbon steels, Stainless steels, Tool steels, Cast irons, Austempered Ductile Iron (ADI), Aluminium alloys, Copper alloys, Nickel alloys, Titanium alloys. Heat treatment defects- Causes and remedies.								
L:45, SL :45, Total:90 Hours								
Weightage: Continuous Assessment 40% End Semester Examinations 60%								
REFERENCE BOOKS:								
1.	ASM International. (2023). <i>ASM Handbook Volume 4A: Steel Heat Treating Fundamentals and Processes</i> .							
2.	ASM International. (2023). <i>ASM Handbook Volume 4B: Steel Heat Treating Technologies</i> .							

3.	Rajan.T.V etc (2019), Principles of heat treatment of <i>Steel</i> . Prentice Hall India [p] Ltd
4.	George Krauss. (2021). <i>Steels: Processing, Structure and Performance</i> (3rd Edition). ASM International.
5.	Raghavan, V. (2020). <i>Physical Metallurgy: Principles and Practice</i> (4th Edition). PHI Learning

E-RESOURCES:

1.	NPTEL – Heat Treatment of Steels
2.	NPTEL – Physical Metallurgy
3.	ASM International Digital Library
4.	DoITPoMS – University of Cambridge
5.	AZoM Materials Database

COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Apply phase transformation concepts to select appropriate heat treatment cycles for engineering materials.	PO1	PSO1
CO2	Apply hardenability, tempering and heat treatment principles for improving material performance.	PO1, PO2	PSO1
CO3	Analyze heat treatment processes, case hardening methods and process parameters affecting microstructure and properties.	PO2	PSO1, PSO2
CO4	Evaluate heat treatment equipment, atmosphere control and quenching techniques for industrial applications.	PO2, PO3	PSO2
CO5	Evaluate suitable heat treatment procedures for steels, cast irons and non-ferrous alloys to achieve desired properties.	PO2, PO3, PO5	PSO1, PSO2
CO6	Create optimized heat treatment schedules to minimize defects and improve engineering performance of metallic materials.	PO3, PO4, PO5, PO11	PSO1, PSO2, PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
CO1	3											3		
CO2	3	2										3		
CO3		3										2	2	
CO4		3	3										2	
CO5		3	3		2							3	2	
CO6			3	3	3							3	2	2

Activities:

1.	Technical Poster on Industrial Heat Treatment Processes and Applications
2.	Technical Seminar Presentation on Recent Advances in Heat Treatment Technology and Surface Engineering (Independent Study)

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Technical Content	20	Comprehensive and technically accurate	Adequate coverage	Limited coverage
2.	Understanding of Metallurgical Concepts	20	Excellent understanding demonstrated	Good understanding	Basic understanding
3.	Organization and Presentation	20	Well-organized and logically structured	Adequately organized	Poor organization
4.	Visual Effectiveness	20	Clear and attractive presentation	Adequate visual presentation	Limited visual appeal
5.	Response to Questions	20	Accurate and confident responses	Adequate responses	Limited responses
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Technical Depth	20	In-depth understanding and analysis	Adequate technical depth	Limited technical depth
2.	Literature Survey	20	Comprehensive review of literature	Adequate review	Limited review
3.	Presentation Skills	20	Excellent communication and delivery	Good communication	Average communication
4.	Technical Discussion	20	Effective discussion with critical analysis	Adequate discussion	Limited discussion
5.	Report Quality	20	Professional quality report	Acceptable report	Poor documentation
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	12	12	-	-	12	2
CO2	24	24	-	-	24	3
CO3	16	16	-	-	16	2
CO4	8	8	-	-	8	1
CO5	-	-	40		25	3
CO6	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MT404		IRON AND STEEL MAKING		SEMESTER			IV		
Prerequisites				Category	ES(PC)	Credits			3
Metallurgical Thermodynamics & Mineral Dressing, Fuels and Furnaces				Hours/ Semester	L	T	P	SL	TH
					45	-	-	45	90
COURSE OBJECTIVES									
1.	Able to evaluate raw material characterization, agglomeration methods, and Fe-O-C/H reduction thermodynamics in iron extraction.								
2.	Able to diagnose blast furnace operational dynamics, process irregularities, and alternative direct reduction routes.								
3.	Able to compare the design, blowing mechanisms, and mass-energy balances of primary oxygen and electric steelmaking processes.								
4.	Able to apply physical chemistry, kinetic principles, and slag thermodynamics to optimize refining reactions and impurity removal.								
5.	Able to assess secondary ladle refining practices, continuous casting defect prevention, and sustainable green steelmaking innovations.								
UNIT - I		RAW MATERIALS, AGGLOMERATION, AND THERMODYNAMICS OF IRON REDUCTION							9
Raw Materials & Agglomeration: Iron ore characterization, high alumina challenges, coking coal quality (CRI/CSR), flux requirements, sintering, pelletizing, and burden testing (RDI/RI). Reduction Thermodynamics & BF Chemistry: Fe-O-C/H equilibria, direct/indirect reduction, BF zone reactions, Gruner's theorem, Rist/Reichard diagrams.									
UNIT - II		BLAST FURNACE DESIGN, OPERATION, CONTROL, AND ALTERNATIVE IRONMAKING							9
Design, Operation & Control: Blast furnace geometry, bell/bell-less tops, Cowper stoves, gas cleaning systems, high top pressure, PCI injection, RAFT calculations, and cohesive zone gas dynamics. Irregularities, Refractories & DR Routes: Diagnostics and remedies for BF irregularities (hanging, slipping), refractory wear mechanisms, Alternative route of iron making: direct reduction processes (SL/RN, MIDREX, HYL), and ferro-alloy production.									
UNIT - III		PRIMARY STEELMAKING PROCESSES (OXYGEN & ELECTRIC ROUTES)							9
Oxygen Steelmaking Routes: History of steel making, Reasons for the decline of conventional routes, LD converter design, supersonic lances, LD process characteristics, blow sequences, bottom-blown (OBM) and combined blowing (K-BOP, EOF) mechanisms. Electric Routes & Process Analysis: EAF construction, scrap/DRI charging, EBT, oxy-fuel burners, induction furnaces, mass-energy balance, and environmental recycling.									
UNIT - IV		PHYSICAL CHEMISTRY AND THERMODYNAMICS OF STEELMAKING							9
Reaction Kinetics & Slag Thermodynamics: Physical chemistry and kinetics of decarburization, dephosphorization, desulfurization, C-O bubble nucleation, slag structural theories, and foaming slag control. Interfaces, Deoxidation & Pretreatments: Slag-metal interfacial kinetics, oxygen transport mechanisms, complex deoxidation, synthetic slag practice, and external hot metal pretreatments.									
UNIT - V		SECONDARY STEELMAKING, CASTING TECHNOLOGIES, AND SUSTAINABILITY							9
Ladle Metallurgy & Vacuum Refining: Inert gas stirring, inclusion engineering, ladle furnace (LF) practice, vacuum degassing (VD, RH/DH), and stainless-steel refining (AOD, VOD). Casting Technologies & Sustainability: Ingot defects, continuous casting components (tundish, mould oscillation, EMS), defect prevention, Introduction to mathematical modelling, CCUS, and green steel (H2-DRI).									
L:45, SL :45, Total:90 Hours									

Weightage: Continuous Assessment 40% End Semester Examinations 60%			
REFERENCE BOOKS:			
1.	Ghosh, A. & Chatterjee, A. (2008). <i>Ironmaking and Steelmaking: Theory and Practice</i> (Eastern Economy Edition). PHI Learning Pvt. Ltd. / Prentice Hall of India, New Delhi.		
2.	Chakrabarti, A.K. (2007). <i>Steel Making</i> . Prentice-Hall of India Pvt. Ltd., New Delhi.		
3.	Tupkary, R.H. &Tupkary, V.R. <i>An Introduction to Modern Iron Making & Steel Making</i> , Khanna Publishers, New Delhi.		
4.	Peacey, J.G. & Davenport, W.G. (1979). <i>The Iron Blast Furnace: Theory and Practice</i> . Pergamon Press, Oxford.		
5.	Biswas, A.K. (1981). <i>Principles of Blast Furnace Ironmaking</i> . SBA Publications, Kolkata.		
6.	Cramb, A.W. (Ed.). (2003). <i>The Making, Shaping and Treating of Steel</i> (11th Ed., Vol. 1: Ironmaking Volume & Vol. 2: Steelmaking Volume). AISE Steel Foundation, Pittsburgh.		
7.	Kudrin, V. (1985). <i>Steel Making</i> . Mir Publishers, Moscow.		
E-RESOURCES:			
1.	NPTEL / Swayam Courses -: ● <i>Principles of Ironmaking</i> — Prof. S.C. Koria (IIT Kanpur) ● <i>Steelmaking Physics & Thermodynamics</i> — Prof. Dipak Mazumdar (IIT Kanpur)		
2.	Industrial Handbooks: ● <i>ASM Handbook, Volume 15: Casting</i> , ASM International.		
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Apply the principles of raw material characterization, agglomeration techniques, and thermodynamics of Fe–O–C/H systems to evaluate iron extraction processes.	PO1	PSO1, PSO2
CO2	Analyze blast furnace operations, process irregularities, burden distribution, gas flow behavior, and alternative iron making routes for efficient iron production.	PO1, PO2, PO4	PSO1, PSO2
CO3	Analyze the design, operating principles, and mass-energy relationships of oxygen and electric steel making processes.	PO1, PO2, PO3	PSO1, PSO2
CO4	Evaluate steelmaking reactions using thermodynamic, kinetic, and slag chemistry principles to optimize refining and impurity removal processes.	PO2, PO3, PO4, PO5	PSO1, PSO2, PSO3
CO5	Create a technical report or poster on sustainable iron and steelmaking technologies, including hydrogen-based reduction, CCUS, secondary refining, and continuous casting innovations considering environmental and economic impacts.	PO6, PO7, PO9, PO10, PO11	PSO3, PSO4
CO6	Create and present an independent study on recent advances in green steelmaking, process modelling, energy efficiency, and industrial decarbonization strategies.	PO5, PO6, PO9, PO10, PO11	PSO3, PSO4

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	-	2	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO4	2	3	3	2	2	-	-	-	-	-	-	3	3	2
CO5	-	-	-	-	-	3	2	2	3	2	3	-	-	3
CO6	-	-	-	-	2	3	-	2	3	2	3	-	-	3

Activities:

1.	Technical Poster / Group Presentation on Emerging Sustainable Iron and Steelmaking Technologies: Hydrogen-Based Reduction, CCUS, and Green Steel Production
2.	Independent Study / Technical Seminar on Recent Advances in Secondary Steelmaking, Continuous Casting, Mathematical Modelling, and Decarbonization Strategies

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (14–20)	Good (7–13)	Satisfactory (1–6)
1.	Technical Content	20	Comprehensive and accurate	Adequate	Limited
2.	Sustainability Analysis	20	Excellent environmental and economic evaluation	Good analysis	Basic analysis
3.	Organization & Presentation	20	Well structured	Adequate	Poor
4.	Visual Effectiveness	20	Excellent visuals	Adequate	Limited
5.	Response to Questions	20	Accurate and confident	Adequate	Limited
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (14–20)	Good (7–13)	Satisfactory (1–6)
1.	Technical Depth	20	In-depth analysis	Adequate	Limited
2.	Literature Survey	20	Comprehensive review	Adequate review	Limited review
3.	Presentation Skills	20	Excellent communication	Good	Average

4.	Critical Discussion	20	Strong analytical discussion	Adequate	Limited
5.	Report Quality	20	Professional report	Acceptable	Poor
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12	-	-	12	2
C02	24	24	-	-	24	3
C03	16	16	-	-	16	2
C04	8	8	-	-	8	1
C05	-	-	40		25	3
C06	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MT405		METALLOGRAPHY LABORATORY		SEMESTER				IV
Prerequisites			Category	ES(PC)	Credits			2
Metallurgical Thermodynamics, Mineral Dressing, Fuels and Furnaces			Hours/ Semester	L	T	P	SL	TH
				0	0	45	15	60
COURSE OBJECTIVES								
1.	To develop practical skills in specimen preparation and metallographic examination of engineering materials.							
2.	To identify and characterize the microstructures of ferrous and non-ferrous alloys using metallurgical microscopy.							
3.	To determine grain size, inclusion content, and microstructural features using standard metallographic techniques.							
4.	To correlate microstructures with processing conditions and engineering properties of metallic materials.							
5.	To interpret metallographic observations for quality control and materials characterization applications							
List of Experiments								
1.	Prepare metallographic specimens and study the metallurgical microscope.							
2.	Examine the microstructure of unetched cast irons.							
3.	Examine the microstructure of etched cast irons.							
4.	Analyze the microstructure of pure iron and plain carbon steels.							
5.	Determine ASTM grain size of metallic specimens.							
6.	Examine the microstructure of tool steels and stainless steels.							
7.	Analyze the microstructure of cast and wrought aluminium alloys.							
8.	Examine the microstructure of copper alloys.							
9.	Perform sulphur and phosphorus printing on steel specimens.							
10.	Evaluate non-metallic inclusions using inclusion rating methods.							
P:45, SL:15, Total: 60 Hours								
Weightage: Continuous Assessment 60% End Semester Examinations 40%								
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to				Mapping POs		Mapping PSOs		
CO1	Apply metallographic specimen preparation techniques including mounting, grinding, polishing and etching for microstructural examination.			PO5		PSO2		
CO2	Analyze the microstructures of ferrous materials including cast irons, steels and stainless steels using metallurgical microscopy.			PO1, PO4		PSO1, PSO2		
CO3	Analyze the microstructures of non-ferrous alloys and correlate processing history with observed microstructural characteristics.			PO2, PO4		PSO2		

C04	Evaluate grain size, inclusions and metallurgical quality of engineering materials using ASTM standards and metallographic techniques.	PO2, PO5	PSO1, PSO2
C05	Evaluate metallographic results for material characterization, quality assessment and defect identification in engineering components.	PO2, PO5, PO6	PSO1, PSO3
C06	Create comprehensive metallographic reports by integrating microstructural observations with engineering applications and quality assessment.	PO3, PO5, PO9	PSO2, PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
C01					3								3	
C02	3			3								2	2	
C03		3		3									3	
C04		3			3							2	2	
C05		3			3	2						2		2
C06			3		3				3				2	2

Activities:

1.	Metallography Poster Presentation
2.	Metallurgical Microstructure Technical Seminar

Rubrics for evaluation: C05

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Microstructure Interpretation	20	Accurate identification and complete interpretation	Minor interpretation errors	Limited interpretation
2.	Inclusion & Grain Size Evaluation	20	Correct ASTM evaluation with proper justification	Minor calculation/interpretation errors	Incomplete evaluation
3.	Quality Assessment	20	Comprehensive assessment supported by microstructure	Adequate assessment	Limited assessment
4.	Correlation with Material Properties	20	Excellent correlation between structure and properties	Reasonable correlation	Poor correlation

5.	Record & Viva-Voce	20	Excellent documentation and technical explanation	Good documentation	Incomplete documentation
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Specimen Preparation	20	Excellent preparation with defect-free surface	Minor preparation defects	Poor preparation
2.	Micrograph Acquisition	20	Clear and properly focused micrographs	Minor image quality issues	Poor image quality
3.	Analysis & Material Identification	20	Accurate material identification with justification	Reasonably accurate identification	Incorrect identification
4.	Engineering Interpretation	20	Comprehensive engineering significance explained	Adequate interpretation	Limited interpretation
5.	Technical Report & Presentation	20	Professional report and presentation	Good documentation	Poor documentation
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Evaluation of Student Work, Observation of Record and Model Test	Activities	Percentage allocation	Mapping Strength
CO1	20	20	20	2
CO2	20	20	20	2
CO3	20	20	20	2
CO4	20	20	20	2
CO5	10	10	10	2
CO6	10	10	10	2
Total	100	100	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MT406	MATERIALS TESTING LABORATORY			Semester			IV				
Prerequisites				Category	ES(PC)	Credit		2			
Mechanical behavior and testing of materials				Hours/ Semester	L	T	P	SL	TH		
					0	0	45	15	60		
Course Learning Objectives											
1.	To conduct the different material testing principles, procedures and evaluate the material properties.										
EXPERIMENTS											
1.	Tensile testing of Metals and Alloys										
2.	Compression test										
3.	Impact testing of Metals (Charpy & Izod)										
4.	Bend Test of Metals										
5.	Hardness–Brinell & Rockwell										
6.	Hardness–Vickers										
7.	Micro hardness test										
8.	Fatigue test										
9.	Wear test–Pinondisc										
10.	Creep test (using lead wire)										
P:45, SL:15, Total: 60 Hours											
Weightage:											
Continuous Assessment 60%											
End Semester Examinations 40%											
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to										Mapping POs	Mapping PSOs
CO1	Apply standard testing procedures to determine the mechanical properties of metals and alloys using tensile, compression, bend and impact tests.				PO1, PO5			PSO1, PSO2			
CO2	Analyze the hardness and microhardness behaviour of metals and alloys using appropriate testing techniques and interpret the test results.				PO1, PO4, PO5			PSO1, PSO2			
CO3	Analyze fatigue, wear and creep behaviour of engineering materials from experimental observations and test data.				PO1, PO4, PO5			PSO1, PSO2			
CO4	Evaluate the mechanical performance of metals and alloys by comparing experimental results obtained from different material testing methods.				PO2, PO4, PO5			PSO1, PSO2			
CO5	Create a structured experimental report incorporating test procedures, observations, calculations, results and engineering interpretation of material testing experiments.				PO2, PO9, PO11			PSO1, PSO3			
CO6	Create an independent technical presentation on material testing methods, recent testing practices or applications of mechanical testing in engineering materials.				PO5, PO9, PO11			PSO2, PSO3			

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO 1	PSO 2	PSO 3
CO1	–	–	–	3	–	–	–	–	–	–	3	2	–	–
CO2	–	–	2	3	–	–	–	–	–	–	3	3	–	–
CO3	–	–	3	3	–	–	–	–	–	–	3	3	–	–
CO4	3	–	3	3	–	–	–	–	–	–	3	3	–	–
CO5	3	–	–	–	–	–	–	3	–	2	2	–	3	–
CO6	–	–	–	2	–	–	2	3	–	3	–	2	3	3

Activities:

1.	Technical Poster / Demonstration
2.	Independent Technical Seminar

Rubrics for evaluation: CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Experimental Procedure	20	Procedure presented accurately and systematically	Minor procedural details missing	Incomplete procedure
2.	Observations & Calculations	20	Accurate observations and calculations	Minor errors	Several errors or omissions
3.	Results & Interpretation	20	Results accurately interpreted with sound reasoning	Adequate interpretation	Limited interpretation
4.	Organization & Documentation	20	Well-organized and clearly documented	Adequately organized	Poor organization
5.	Engineering Discussion	20	Excellent discussion of material behaviour and test significance	Good discussion	Basic discussion
	Total	100			

Rubrics for evaluation: CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Technical Content	20	Comprehensive and technically accurate	Adequate coverage	Limited coverage
2.	Literature / Information Survey	20	Relevant and comprehensive sources	Adequate sources	Limited sources

3.	Understanding of Testing Concepts	20	Excellent understanding demonstrated	Good understanding	Basic understanding
4.	Presentation & Visual Effectiveness	20	Clear, well-organized and effective	Adequate presentation	Poor presentation
5.	Response to Questions	20	Accurate and confident responses	Adequate responses	Limited responses
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Evaluation of Student Work, Observation of Record and Model Test	Activities	Percentage allocation	Mapping Strength
CO1	20	20	20	2
CO2	20	20	20	2
CO3	20	20	20	2
CO4	20	20	20	2
CO5	10	10	10	2
CO6	10	10	10	2
Total	100	100	100	

Note: Purely as an Example: Strength = 3 (if percentage >20%);
Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MCC02	ENVIRONMENTAL SCIENCE AND ENGINEERING		SEMESTER				IV
Prerequisites		Category	MC	Credits			3
Nil		Hours/ Semester	L	T	P	SL	TH
			45	-	-	45	90
COURSE OBJECTIVES							
1.	To understand the fundamental concepts of ecology, biodiversity, environmental pollution, sustainable energy resources, climate change, and environmental sustainability relevant to engineering and society.						
2.	To acquire the ability to analyze environmental issues, pollution sources, biodiversity conservation strategies, and climate change mitigation measures using scientific principles.						
3.	To examine the interrelationships between ecosystems, energy resources, environmental management practices, and sustainable development goals.						
4.	To assess the suitability of sustainable technologies, renewable energy resources, environmental policies, and management strategies for addressing environmental challenges.						
5.	To develop practical and self-learning skills through environmental observations, case studies, field-based activities, and sustainability assessments, and to interpret findings for real-world applications.						
UNIT - I		ECOLOGY AND BIODIVERSITY:					9
Ecology – Definition, ecosystem – types – components (biotic and abiotic) – function – energy flow in ecosystem – components of forest, desert, river and ocean ecosystem – food chain and food web – ecological pyramid – ecological succession. Biodiversity – levels – values – biodiversity hot spots and hope spots in India – endangered and endemic species – threats and conservation of biodiversity.							
Activities 1. Study of local ecosystem and identification of biotic and abiotic components. 2. Documentation of local biodiversity and endangered species.							
UNIT - II		ENVIRONMENTAL POLLUTION:					9
Air pollution – sources, effects, control measures – Water pollution –sources, effects, control measures – Noise pollution – sources, effects, control measures –Soil pollution – causes, effects and control measures – solid and electronic waste management – Environmental protection acts.							
Activities 1. Survey of air, water, noise, and solid waste pollution sources in the locality. 2. Preparation of waste segregation and management plan.							
UNIT - III		SUSTAINABLE ENERGY RESOURCES:					9
Energy management and conservation – Need of new sources – Different types new energy sources – Applications of solar energy, wind energy, hydrogen energy, ocean energy and tidal energy – Concept, origin and power plants of geothermal energy.							
Activities 1. Comparative study of renewable and non-renewable energy resources. 2. Energy audit of classroom/home.							

UNIT - IV		CLIMATE CHANGE AND MANAGEMENT:		9
Causes for climate change – global warming – greenhouse effect – acid rain– ozone layer depletion – carbon sequestration, carbon foot print, carbon credit, Kyoto protocol – green climate fund (GCF), climate investment fund (CIF) – intergovernmental panel on climate change (IPCC) – clean development mechanism (CDM) – Paris agreement.				
Activity Carbon footprint estimation of an individual or institution.				
UNIT - V		ENVIRONMENTAL SUSTAINANILITY AND PRACTICES:		9
Sustainability – concept, needs and challenges – economic, social, and environmental aspects of sustainability – transition from unsustainability to sustainability – sustainable development goals (SDGs) – targets, indicators, and intervention areas – zero waste and R concepts – environmental impact assessment (EIA) – sustainable habitat – green buildings, green materials, sustainable transport.				
Activity Sustainability assessment of campus/community.				
L:45, SL:45, Total:90 Hours				
Weightage: Continuous Assessment 40% End Semester Examinations 60%				
REFERENCE BOOKS:				
1.	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.			
2.	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi 2016.			
3.	Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.			
4.	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.			
5.	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.			
E-RESOURCES:				
1.	www.ePathshala.nic.in			
2.	www.onlinecourses.nptel.ac.in/			
3.	eGyanKosh – IGNOU Repository (http://egyankosh.ac.in)			
4.	https://www.unep.org			
5.	MIT OpenCourseWare (https://ocw.mit.edu)			
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to			Mapping POs	Mapping PSOs
CO1	Explain the principles of ecology, biodiversity, environmental pollution, sustainable energy resources, climate change, and environmental sustainability.		---	---

CO2	Apply environmental concepts and scientific principles to analyze ecosystem functions, pollution problems, biodiversity conservation, and sustainable energy utilization.	PO1	---
CO3	Analyze environmental challenges by correlating ecological processes, pollution impacts, climate change effects, and sustainability indicators.	PO2, PO7	---
CO4	Assess renewable energy technologies, climate management strategies, environmental policies, and sustainability practices for engineering applications.	PO6, PO7	---
CO5	Perform environmental observations, field studies, sustainability assessments, and activity-based investigations, and interpret the results using scientific methods.	PO8	---
CO6	Engage in self-learning activities related to environmental management, biodiversity conservation, renewable energy, climate action, and sustainable development and communicate the findings effectively.	PO9, PO11	---

The Course Articulation Matrix (CAM) for defined COs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1														
CO2	3													
CO3		3					3							
CO4						2	2							
CO5								2						
CO6									2		2			

Activities:

1.	Conduct field-based and activity-oriented studies related to ecosystems, biodiversity, environmental pollution, renewable energy resources, climate change impacts, carbon footprint assessment, waste management, and sustainability practices, and prepare reports based on observations and findings. (CO5) (Individual and Collaborative Team Work)
2.	i) A comprehensive environmental impact assessment study on environmental sustainability, public welfare, regulatory compliance, and ethical responsibilities. (CO4) (Independent study) ii) Participate in self-learning activities such as seminars, case studies, quizzes, presentations, and literature reviews on environmental conservation, sustainable energy technologies, climate agreements, environmental legislation, SDGs, green buildings, and sustainable transportation systems. (CO6) (Independent study)

Rubrics for evaluation:CO4

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Environmental Sustainability Assessment	10	Comprehensive evaluation of environmental impacts and sustainability measures with strong supporting evidence.	Adequate evaluation of major environmental impacts and sustainability aspects.	Limited or incomplete assessment of environmental sustainability.
2.	Public Welfare and Societal Impact Analysis	5	Thorough analysis of impacts on public health, safety, and community welfare with clear justification.	Identifies key societal impacts with moderate analysis.	Limited discussion of public welfare and societal impacts.
3.	Regulatory Compliance Evaluation	5	Clearly assesses compliance with relevant environmental laws, regulations, and standards.	Addresses major regulatory requirements with some gaps.	Minimal or inaccurate assessment of regulatory compliance.
	Total	20			

Rubrics for evaluation:CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Understanding of Environmental Concepts	10	Demonstrates thorough understanding and accurate interpretation	Good understanding with minor gaps	Basic understanding
2.	Data Collection and Observation	10	Accurate, systematic, and comprehensive observations	Mostly accurate observations	Adequate observations
3.	Analysis and Interpretation	10	Excellent scientific analysis and interpretation	Good analysis with minor errors	Basic analysis
4.	Report / Presentation Quality	10	Clear, organized, and professional	Well organized with minor issues	Moderately organized
	Total	40			

Rubrics for evaluation:CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good(2)	Satisfactory (1)
1.	Conceptual Clarity	10	Complete understanding and clarity	Good understanding	Moderate understanding

2.	Accuracy of Content	5	Scientifically accurate and comprehensive	Mostly accurate	Some inaccuracies
3.	Participation and Preparedness	5	Highly engaged and well prepared	Well prepared	Partially prepared
	Total	20			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
C01	12	12			12	2
C02	24	24			24	3
C03	24	24			24	3
C04				20	10	2
C05			40		20	2
C06				20	10	2
Total	60	60	40	40	100	

Note:Purely as anExample: Strength = 3 (if percentage >20%);

Strength =2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);

26MCC04	DISASTER MANAGEMENT AND PREPAREDNESS		SEMESTER				IV	
PREREQUISITES			Category	MC	Credits			0
NIL			Hours/ Semester	L	T	P	SL	TH
				30	0	0	30	60
COURSE OBJECTIVES								
1.	To provide students an exposure to disasters, their significance and types.							
2.	To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction							
3.	To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)							
4.	To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.							
5.	To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.							
UNIT - I	INTRODUCTION TO DISASTERS							6
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.								
UNIT - II	APPROACHES TO DISASTER RISK REDUCTION (DRR)							6
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- non structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority (SDMA) – Early Warning System – Advisories from Appropriate Agencies.								
UNIT - III	DISASTER RISK MANAGEMENT IN INDIA							6
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment								
UNIT - IV	DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS							6
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.								
UNIT - V	DISASTER PREPAREDNESS AND MANAGEMENT							6
Disaster Preparedness Concepts - Preparedness: - Roles and Responsibilities - Preparedness for Relief and Rescue - Technology in Preparedness - Community Preparedness - Monitoring of Phenomena Triggering a Disaster or Hazard, Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Case Studies for Preparedness.								

Total : 30+30= 60 Hours			
Weightage: Continuous Assessment 100%			
REFERENCE BOOKS:			
1.	Disaster Management: Risk. Response. Recovery. by Dr. Raj Laxmi Dr. Amit Sinha (2025)		
2.	Disaster Management by Shaikh Ubaid (Author)" 2020 . First Edition Technical Publications.		
3.	Disaster Management" AUTHOR: K.Sriram Kumar, P. Krishna Sankar, S. Arunprasath - PUBLICATION: ARS		
4.	Govt. of India: Disaster Management Act , Government of India, New Delhi, 2025.		
5.	Government of India, National Disaster Management Policy,2023.		
E-RESOURCES:			
1.	National Disaster Management Authority (NDMA), Government of India		
2.	https://www.youtube.com/@ndmaindia		
3.	Disaster Management and Environmental Studies MOOCs.		
4.	National Institute of Disaster Management (NIDM)		
5.	YouTube: NIDM YouTube Channel		
COURSE OUTCOMES (COs) / At the end of the course, the students will have the ability to		Mapping POs	Mapping PSOs
CO1	Explain the concepts of disasters, hazards, vulnerability, resilience, risk, and their impacts on society, economy, environment, and public health.	PO1	PO1
CO2	Apply disaster risk reduction (DRR) principles, disaster cycle concepts, and community-based approaches for disaster preparedness and mitigation.	PO2, PO6	PSO1
CO3	Analyze disaster risk management frameworks, institutional mechanisms, and disaster policies in India for effective disaster response and recovery.	PO2, PO3, PO6	PSO2
CO4	Evaluate disaster case studies using GIS, remote sensing, early warning systems, and information technology tools for risk assessment and management.	PO4, PO5	PSO1
CO5	Conduct field studies, case studies, and self-learning activities related to natural and man-made disasters, and assess their societal, environmental, and economic impacts.	PO6, PO7, PO9, PO10	PSO2
CO6	Develop disaster preparedness and management strategies for communities by integrating technological tools, risk monitoring techniques, and sustainable disaster management practices.	PO3, PO5, PO6, PO9, PO10, PO11	PSO3

The Course Articulation Matrix (CAM) for defined COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PSO1	PSO2	PSO3
CO1	3	--	--	--	--	--	--	--	--	--	--	--	--	--
CO2	--	3	--	--	--	2	--	--	--	--	--	--	--	--
CO3	--	3	2	--	--	3	--	--	--	--	--	--	--	--
CO4	--	--	--	3	3	--	--	--	--	--	--	3	--	--
CO5	--	--	--	--	--	3	3	--	3	3	--	--	3	--
CO6	--	--	2	--	3	3	2	--	3	3	3	--	--	3

Activities:

1.	Activity 1 (CO5): Case Study / Field Work ➤ Flood Risk Assessment ➤ Landslide Hazard Mapping ➤ Cyclone Impact Assessment ➤ Forest Fire Analysis ➤ Disaster Relief Camp Evaluation
2.	Activity 2 (CO6): Technical Seminar / Mini Project ➤ Community Disaster Preparedness Plan ➤ GIS-based Disaster Mapping ➤ Early Warning System Design ➤ Disaster Response and Recovery Plan ➤ Campus Disaster Management Plan

Rubrics forevaluation:CO5

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Problem formulation & boundary conditions	20	Problem and boundary conditions are clearly defined	Problem defined, but some of the boundary conditions are unclear	Problem statement defined but unclear boundary conditions
2.	Simulation & plots	30	Simulation is done and plots are well-presented	Simulation is done, but minor error in plots	Simulations and plots are incomplete
3.	Interpretation of results	25	Results are clearly Interpreted & justified	Results are interpreted but limited justification	Unclear interpretation
4.	Report presentation	25	Report is clear and well structured	Report is structured, but needs improvement	Poorly structured report
	Total	100			

Rubrics forevaluation:CO6

Sl. No.	Criterion	Marks	Excellent (3)	Good (2)	Satisfactory (1)
1.	Problem identification & case selection	20	Disaster case is clearly identified with relevant scope and boundary conditions defined	Case identified but boundary conditions are partially unclear	Case selection is unclear with weak problem definition
2.	Data collection & analysis	30	Relevant and sufficient data collected; clear analysis of hazard, vulnerability and impacts	Adequate data collected with minor gaps in analysis	Incomplete data collection and weak analysis
3.	Interpretation of disaster impacts	25	Clear interpretation of social, economic, environmental and health impacts with justification	Impacts interpreted but with limited justification	Poor or unclear interpretation of impacts
4.	Report presentation	25	Report is well-structured, clear and professionally presented	Report is structured but needs improvement	Poorly structured and unclear report
	Total	100			

The Internal Assessment Matrix (IAM) for the defined COs:

CO	Test I	Test II	Activity I	Activity II	Percentage allocation	Mapping Strength
CO1	12	12	-	-	12	2
CO2	24	24	-	-	24	3
CO3	16	16	-	-	16	2
CO4	8	8	-	-	8	1
CO5	-	-	40		25	3
CO6	-	-	-	40	25	3
Total	60	60	40	40	100	

Note: Purely as an Example : Strength = 3 (if percentage >20%); Strength = 2 (if percentage 10% to 20%); Strength = 1 (if percentage <10%);