ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
B.E. MATERIALS SCIENCE AND ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES:

1. Have knowledge on the subject & practices in the field of materials science & Engineering
2. Choose their careers as practicing materials engineer in all fields of materials industries
3. Engage in continuous learning & progress to do innovation in the field of materials
4. Adapt to the work environment with exemplary leadership skills.

PROGRAMME OUTCOMES:

a. Ability to apply knowledge of mathematics, science and engineering
b. Ability to design & conduct experiments as well as to analyze and interpret data
c. Ability to design a system, a component or a process to meet desired needs with in realistic constraints such as economic, environment, social, ethical, health and safety, manufacturability & sustainability
d. Ability to function on multidisciplinary teams.
e. Ability to identify, formulate & solve engineering problems.
f. To understand the professional & ethical responsibility.
g. Ability to communicate effectively
h. To understand the impact of engineering solutions in a global, economic & societal context.
i. Ability to engage them in lifelong learning.
j. To have knowledge of contemporary/current issues.
k. Ability to use the techniques, skills & modern engineering tools for engineering practice.
l. Ability to apply fundamental process industries.
& practical knowledge of unit operations & processes, principles of management and economics for providing better services to metallurgical & materials

PEO/PO Mapping

PEO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1	√	√	√		√			√			√	√
2	√	√	√		√			√			√	√
3	√	√	√	√		√			√	√	√	
4				√	√	√	√	√		√	√	√

Semester Course wise PO mapping

		Course Title	a	b	c	d	e	f	g	h	i	j	k	l
YEAR I	SEMESTER I	Communicative English							√		√			
		Engineering Mathematics I	√	√		√	√						√	
		Engineering Physics	√			√	√				√			
		Engineering Chemistry	√			√	√				√			
		Problem Solving and Python Programming		√		√			√					
		Engineering Graphics		√	√		√						√	
		Problem Solving and Python Programming Laboratory	√	√					√				√	√
		Physics and Chemistry Laboratory	√	√					√				√	√
	SEMESTER II	Technical English							√		√			
		Engineering Mathematics– II	√	√		√	√						√	
		Applied Physics	√	√		√	√				√			
		Basic Electrical, Electronics and Instrumentation Engineering	√			√							√	√
		Basic Civil and Mechanical Engineering	√	√			√						√	√
		Engineering Mechanics		√	√	√								
		Engineering Practices Laboratory	√	√					√				√	√
		Basic Electrical, Electronics and Instrumentation Engineering Laboratory	√	√					√				√	√
YEAR II	SEMESTER III	Transforms and Partial Differential Equations	√	√		√	√						√	
		Casting and Machining Processes		√	√	√	√	√				√		√
		Thermodynamics and Kinetics of Materials		√		√	√						√	
		Strength of Materials for Mechanical Engineers	√	√		√	√							
		Materials Structure and Properties	√	√	√		√							√
		Processing of Iron and Steel	√	√	√		√	√		√		√		
		Strength of Materials Laboratory	√	√					√				√	√
		Microstructure Analysis Laboratory	√	√					√				√	√
	SEMESTER IV	Mechanical Behaviour of Materials	√	√	√		√		√			√	√	
		Corrosion and Surface Engineering	√		√	√	√					√		
		Non-Ferrous Metallurgy	√	√		√	√			√				
		Powder Metallurgy	√	√	√	√								
		Environmental Science and Engineering			√			√			√			
		Physical Metallurgy	√	√	√	√	√							
		Manufacturing Technology Laboratory	√	√					√				√	√
		Foundry and Powder Metallurgy Laboratory	√	√					√				√	√
YEAR III	SEMESTER V	Theory and Applications of Metal Forming	√	√	√	√	√						√	√
		Material Aspects in Design	√	√	√									
		Characterization of Materials	√	√	√		√						√	
		Heat Treatment of Metals and Alloys	√	√	√			√			√			
		Ceramics and Refractory Materials	√	√	√	√							√	
		Open Elective - I												
		Heat Treatment Laboratory	√	√					√				√	√
		Metal Forming and Welding Analysis Laboratory	√	√					√				√	√
		Technical Seminar - I	√						√		√	√		

	SEMESTER VI	Polymer Process Engineering	√		√	√	√							
		Composite Materials	√		√	√	√	√			√			
		Industrial Management				√		√	√		√		√	√
		Welding Metallurgy	√	√	√		√					√	√	√
		Non Destructive Evaluation of Materials	√	√	√		√	√					√	√
		Professional Elective – I												
		Composite Materials Laboratory	√	√					√				√	√
		Professional Communication				√			√				√	
		Materials Characterization Laboratory	√	√					√				√	√
YEAR IV	SEMESTER VII	Total Quality Management				√		√	√		√		√	√
		Computer Applications in Materials Science	√	√		√							√	
		Nanostructure Materials	√	√	√	√	√					√	√	√
		Professional Elective - II												
		Professional Elective- III												
		Open Elective - II												
		Computer Aided Simulation and Analysis Laboratory	√	√					√				√	√
		Technical Seminar - II	√				√			√	√			
		Material Design Project	√	√	√	√	√	√	√	√	√	√	√	√
		Industrial / Field Training	√		√	√			√	√			√	√
	SEMESTER	Professional Elective - IV												
		Professional Elective- IV												
		Project Work	√	√	√	√	√	√	√	√	√	√	√	√

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REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	MA8151	Engineering Mathematics - I	BS	4	4	0	0	4
3.	PH8151	Engineering Physics	BS	3	3	0	0	3
4.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE8152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8251	Technical English	HS	4	4	0	0	4
2.	MA8251	Engineering Mathematics - II	BS	4	4	0	0	4
3.	PH8203	Applied Physics	BS	3	3	0	0	3
4.	BE8253	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
5.	BE8252	Basic Civil and Mechanical Engineering	ES	4	4	0	0	4
6.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
PRACTICALS								
7.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	BE8261	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ES	4	0	0	4	2
			TOTAL	**31**	**21**	**2**	**8**	**26**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
2.	ML8301	Casting and Machining Processes	PC	3	3	0	0	3
3.	ML8302	Thermodynamics and Kinetics of Materials	PC	5	3	2	0	4
4.	CE8395	Strength of Materials for Mechanical Engineers	ES	3	3	0	0	3
5.	ML8303	Materials Structure and Properties	PC	3	3	0	0	3
6.	ML8304	Processing of Iron and Steel	PC	3	3	0	0	3
PRACTICALS								
7.	CE8481	Strength of Materials Laboratory	ES	4	0	0	4	2
8.	ML8311	Microstructure Analysis Laboratory	PC	4	0	0	4	2
			TOTAL	**29**	**19**	**2**	**8**	**24**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ML8401	Mechanical Behaviour of Materials	PC	5	3	2	0	4
2.	ML8402	Corrosion and Surface Engineering	PC	3	3	0	0	3
3.	ML8403	Non-Ferrous Metallurgy	PC	3	3	0	0	3
4.	ML8491	Powder Metallurgy	PC	3	3	0	0	3
5.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
6.	ML8404	Physical Metallurgy	PC	3	3	0	0	3
PRACTICALS								
7.	ME8461	Manufacturing Technology Laboratory	PC	4	0	0	4	2
8.	ML8411	Foundry and Powder Metallurgy Laboratory	PC	4	0	0	4	2
			TOTAL	**28**	**18**	**2**	**8**	**23**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ML8501	Theory and Applications of Metal Forming	PC	3	3	0	0	3
2.	ML8502	Material Aspects in Design	PC	5	3	2	0	4
3.	ML8503	Characterization of Materials	PC	3	3	0	0	3
4.	ML8504	Heat Treatment of Metals and Alloys	PC	3	3	0	0	3
5.	ML8505	Ceramics and Refractory Materials	PC	3	3	0	0	3
6.		Open Elective - I	OE	3	3	0	0	3
PRACTICALS								
7.	ML8511	Heat Treatment Laboratory	PC	4	0	0	4	2
8.	ML8512	Metal Forming and Welding Analysis Laboratory	PC	4	0	0	4	2
9.	ML8513	Technical Seminar - I	EEC	2	0	0	2	1
			TOTAL	**30**	**18**	**2**	**10**	**24**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ML8601	Polymer Process Engineering	PC	3	3	0	0	3
2.	ML8602	Composite Materials	PC	3	3	0	0	3
3.	MG8691	Industrial Management	PC	3	3	0	0	3
4.	ML8603	Welding Metallurgy	PC	3	3	0	0	3
5.	ML8604	Non Destructive Materials of Evaluation	PC	3	3	0	0	3
6.		Professional Elective – I	PE	3	3	0	0	3
PRACTICALS								
7.	ML8611	Composite Materials Laboratory	PC	4	0	0	4	2
8.	ML8612	Materials Characterization Laboratory	PC	4	0	0	4	2
9.	HS8581	Professional Communication	EEC	2	0	0	2	1
			TOTAL	**28**	**18**	**0**	**10**	**23**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	GE8077	Total Quality Management	HS	3	3	0	0	3
2.	ML8701	Computer Applications in Materials Science	PC	3	3	0	0	3
3.	ML8702	Nanostructure Materials	PC	3	3	0	0	3
4.		Professional Elective - II	PE	3	3	0	0	3
5.		Professional Elective- III	PE	3	3	0	0	3
6.		Open Elective - II	OE	3	3	0	0	3
PRACTICALS								
7.	MF8761	Computer Aided Simulation and Analysis Laboratory	PC	4	0	0	4	2
8.	ML8711	Technical Seminar - II	EEC	2	0	0	2	1
9.	ML8712	Material Design Project	PC	4	0	0	4	2
10.	ML8713	Industrial / Field Training	EEC	0	0	0	0	1
			TOTAL	**28**	**18**	**0**	**10**	**24**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective IV	PE	3	3	0	0	3
2.		Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
3.	ML8811	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS:185

HUMANITIES AND SOCIAL SCIENCES (HS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	HS8251	Technical English	HS	4	4	0	0	4
3.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
4.	GE8077	Total Quality Management	HS	3	3	0	0	3

BASIC SCIENCE (BS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA8151	Engineering Mathematics I	BS	4	4	0	0	4
2.	PH8151	Engineering Physics	BS	3	3	0	0	3
3.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
5.	MA8251	Engineering Mathematics II	BS	4	4	0	0	4
6.	PH8203	Applied Physics	BS	3	3	0	0	3
7.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
2.	GE8152	Engineering Graphics	ES	6	2	0	4	4
3.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
4.	BE8253	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
5.	BE8252	Basics of Civil and Mechanical Engineering	ES	3	4	0	0	4
6.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
7.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	BE8261	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ES	4	0	0	4	2
9.	CE8395	Strength of Materials for Mechanical Engineers	ES	3	3	0	0	3
10.	CE8481	Strength of Materials Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ML8301	Casting and Machining Processes	PC	3	3	0	0	3
2.	ML8302	Thermodynamics and Kinetics of Materials	PC	5	3	2	0	4
3.	ML8303	Materials Structure and Properties	PC	3	3	0	0	3
4.	ML8304	Processing of Iron and Steel	PC	3	3	0	0	3
5.	ML8311	Microstructure Analysis Laboratory	PC	4	0	0	4	2
6.	ML8401	Mechanical Behaviour of Materials	PC	5	3	2	0	4
7.	ML8402	Corrosion and Surface Engineering	PC	3	3	0	0	3
8.	ML8403	Non-Ferrous Metallurgy	PC	3	3	0	0	3
9.	ML8491	Powder Metallurgy	PC	3	3	0	0	3
10.	ML8404	Physical Metallurgy	PC	3	3	0	0	3
11.	ME8461	Manufacturing Technology Laboratory	PC	4	0	0	4	2
12.	ML8411	Foundry and Powder Metallurgy Laboratory	PC	4	0	0	4	2
13.	ML8501	Theory and Applications of Metal Forming	PC	3	3	0	0	3
14.	ML8502	Material Aspects in Design	PC	5	3	2	0	4
15.	ML8503	Characterization of Materials	PC	3	3	0	0	3
16.	ML8504	Heat Treatment of Metals and Alloys	PC	3	3	0	0	3
17.	ML8505	Ceramics and Refractory Materials	PC	3	3	0	0	3
18.	ML8511	Heat Treatment Laboratory	PC	4	0	0	4	2
19.	ML8512	Metal Forming and Welding Analysis Laboratory	PC	4	0	0	4	2
20.	ML8601	Polymer Process Engineering	PC	3	3	0	0	3
21.	ML8602	Composite Materials	PC	3	3	0	0	3
22.	ML8603	Welding Metallurgy	PC	3	3	0	0	3
23.	ML8604	Non Destructive Evaluation of Materials	PC	3	3	0	0	3
24.	ML8611	Composite Materials Laboratory	PC	4	0	0	4	2
25.	ML8612	Materials Characterization Laboratory	PC	4	0	0	4	2
26.	ML8701	Computer Applications in Materials Science	PC	3	3	0	0	3
27.	ML8702	Nanostructure Materials	PC	3	3	0	0	3
28.	MF8761	Computer Aided Simulation and Analysis Laboratory	PC	4	0	0	4	2
29.	ML8712	Material Design Project	PC	4	0	0	4	2
30.	MG8691	Industrial Management	PC	3	3	0	0	3

PROFESSIONAL ELECTIVES FOR MATERIALS SCIENCE AND ENGINEERING

SEMESTER VI, ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ML8001	Modern Manufacturing Process	PE	3	3	0	0	3
2.	ML8002	Bio and Smart Materials	PE	3	3	0	0	3
3.	ML8003	Principle and Application of Extractive Metallurgy	PE	3	3	0	0	3
4.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3
5.	GE8073	Fundamentals of Nano Science	PE	3	3	0	0	3

SEMESTER VII, ELECTIVE II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ML8004	Automotive Materials	PE	3	3	0	0	3
2.	ME8793	Process Planning and Cost Estimation	PE	3	3	0	0	3
3.	AT8091	Manufacturing of Automotive Components	PE	3	3	0	0	3
4.	ME8072	Renewable Sources of Energy	PE	3	3	0	0	3
5.	MF8071	Additive Manufacturing	PE	3	3	0	0	3
6.	GE8071	Disaster Management	PE	3	3	0	0	3

SEMESTER VII, ELECTIVE III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ML8005	Industrial Tribology	PE	3	3	0	0	3
2.	ML8006	Cryogenic Treatment of Materials	PE	3	3	0	0	3
3.	ML8007	Fuel, Furnaces and Refractories	PE	3	3	0	0	3
4.	ML8008	Nuclear Reactor Materials	PE	3	3	0	0	3
5.	GE8074	Human Rights	PE	3	3	0	0	3

SEMESTER VIII, ELECTIVE IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ML8009	Fracture Mechanics and Failure Analysis	PE	3	3	0	0	3
2.	ML8010	Finite Element Analysis in Materials Engineering	PE	3	3	0	0	3
3.	ML8011	Alloy Casting Processes	PE	3	3	0	0	3
4.	ML8012	Metallurgy of Tool Materials and Special Steels	PE	3	3	0	0	3
5.	ML8013	Laser Processing of Materials	PE	3	3	0	0	3

SEMESTER VIII, ELECTIVE V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ML8014	Energy Storage Devices and Fuel Cells	PE	3	3	0	0	3
2.	ML8015	Semiconductor Optoelectronic Materials and Devices	PE	3	3	0	0	3
3.	ML8016	Modeling and Simulation in Materials Engineering	PE	3	3	0	0	3
4.	IE8791	Design of Experiments	PE	3	3	0	0	3
5.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ML8513	Technical Seminar-I	EEC	2	0	0	2	1
2.	HS8581	Professional Communication	EEC	4	0	0	2	1
3.	ML8711	Technical Seminar - II	EEC	2	0	0	2	1
4.	ML8713	Industrial / Field Training	EEC	0	0	0	0	1
5.	ML8811	Project Work	EEC	20	0	0	20	10

SUMMARY

SL. NO.	Subject Area	Credits per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	HS	4	4	0	3	0	0	3	0	14	7.56
2	BS	12	7	4	0	0	0	0	0	23	12.43
3	ES	9	15	5	0	0	0	0	0	29	15.6
4	PC	0	0	15	20	20	19	10	0	84	45.4
5	PE	0	0	0	0	0	3	6	6	15	8.10
6	OE	0	0	0	0	3		3	0	6	3.24
7	EEC	0	0	0	0	1	1	2	10	14	7.56
	TOTAL	**25**	**26**	**24**	**23**	**24**	**23**	**24**	**16**	**185**	
	Non-Credit /(Mandatory)										

		L	T	P	C
HS8151	**COMMUNICATIVE ENGLISH**	**4**	**0**	**0**	**4**

OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12

Reading- short comprehension passages, practice in skimming-scanning and predicting- Writing- completing sentences- - developing hints. Listening- short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information- Language development - Wh - Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development-- prefixes- suffixes- articles.- count/ uncount nouns.

UNIT II GENERAL READING AND FREE WRITING 12

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –Listening- telephonic conversations. Speaking – sharing information of a personal kind—greeting – taking leave- Language development – prepositions, conjunctions Vocabulary development- guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12

Reading - short texts and longer passages (close reading) Writing - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences Listening – listening to longer texts and filling up the table - product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development - degrees of comparison- pronouns - direct vs indirect questions- Vocabulary development – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 12

Reading - comprehension-reading longer texts- reading different types of texts- magazines Writing - letter writing, informal or personal letters-e-mails-conventions of personal email- Listening - listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one's friend- Language development- Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING 12

Reading- longer texts- close reading –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-Listening – listening to talks- conversations- Speaking – participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense - Vocabulary development-collocations- fixed and semi-fixed expressions

TOTAL: 60 PERIODS

OUTCOMES: At the end of the course, learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1 Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.

2 Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007

3 Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005

4 Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011

5 Dutt. P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013

MA8151 ENGINEERING MATHEMATICS – I

L	T	P	C
4	0	0	4

OBJECTIVES :

The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I DIFFERENTIAL CALCULUS 12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

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

UNIT III INTEGRAL CALCULUS 12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS 12

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 DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

TOTAL : 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

PH8151	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND FIBER OPTICS 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.

CY8151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.

Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III ALLOYS AND PHASE RULE 9

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane

number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2013.

REFERENCES:

1. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, “Engineering Chemistry”, Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.

GE8151 PROBLEM SOLVING AND PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

OUTCOMES:

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
5. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

GE8152 ENGINEERING GRAPHICS L T P C
2 0 4 4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT I PLANE CURVES AND FREEHAND SKETCHING 7+12

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

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

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

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

UNIT III PROJECTION OF SOLIDS 5+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

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

TOTAL: 90 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

TEXT BOOK:

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy And Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE8161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

OUTCOMES:

Upon completion of the course, students will be able to

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

TOTAL :60 PERIODS

BS8161 **PHYSICS AND CHEMISTRY LABORATORY** **L T P C**

(Common to all branches of B.E. / B.Tech Programmes) **0 0 4 2**

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

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

- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.
16. Conductometric titration of strong acid vs strong base.

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)

HS8251	TECHNICAL ENGLISH	L	T	P	C
		4	0	0	4

OBJECTIVES:

The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations , participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I INTRODUCTION TECHNICAL ENGLISH 12

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-Vocabulary Development- technical vocabulary Language Development –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 12

Listening- Listening to longer technical talks and completing exercises based on them-Speaking – describing a process-Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing- Writing- interpreting charts, graphs- Vocabulary Development- vocabularyused in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 12

Listening- Listening to classroom lectures/ talkls on engineering/technology -Speaking – introduction to technical presentations- Reading – longer texts both general and technical, practice in speed reading; Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words. Language Development- embedded sentences

UNIT IV REPORT WRITING 12

Listening- Listening to documentaries and making notes. Speaking – mechanics of presentations- Reading – reading for detailed comprehension- Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12

Listening- TED/Ink talks; Speaking –participating in a group discussion -Reading– reading and understanding technical articles Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- verbal analogies Language Development- reported speech

TOTAL 60 PERIODS

OUTCOMES:

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

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

MA8251 ENGINEERING MATHEMATICS – II L T P C
4 0 0 4

OBJECTIVES :

This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES 12

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS 12

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

UNIT IV COMPLEX INTEGRATION 12

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

OUTCOMES :

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PH8203	APPLIED PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To illustrate, with suitable examples, the functioning of conductors, semiconductors, dielectric, magnetic and superconducting materials.
- To make the students familiarize with the optical properties of materials.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - Quantum free electron theory – Particle in a finite potential well – Tunneling- Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – effective number of free electrons - concept of hole.

UNIT II SEMICONDUCTOR PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – four-probe and Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT III DIELECTRICS AND FERROELECTRICS 9

Macroscopic description of the static dielectric constant. The electronic and ionic polarizabilities of molecules - orientational polarization - Measurement of the dielectric constant of a solid. The internal field - Lorentz, Clausius-Mosotti relation. Behaviour of dielectrics in an alternating field, elementary ideas on dipole relaxation, - Piezo, pyro and ferroelectric properties of crystals - classification of ferroelectric crystals - $BaTiO_3$ and KDP.

UNIT IV MAGNETISM AND SUPERCONDUCTIVITY 9

Atomic magnetic moment – classification of magnetic materials: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism and ferrimagnetism - Ferromagnetism: saturation magnetization and Curie temperature – exchange interaction - Domain theory – M versus H behavior – soft and hard magnetic materials -. Quantum Hall effect - Superconductivity – Zero resistance and the Meissner effect – Type I and Type II superconductors – critical current density - BCS theory of superconductivity - Elements of high temperature superconductivity (basic concepts only).

UNIT V OPTICAL PROPERTIES OF MATERIALS 9

Light waves in a homogeneous medium - refractive index - dispersion: refractive index-wave-length behaviour - group velocity and group index – NLO materials – phase matching - SHG, sum frequency generation, parametric oscillations – difference frequency generation (qualitative)-applications- - complex refractive index and light absorption - Luminescence, phosphors and white LEDs - polarization - optical anisotropy: uniaxial crystals, birefringence, dichroism - electro-optic effect and amplitude modulators- electro-absorption.

TOTAL : 45 PERIODS

OUTCOMES:

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

- gain knowledge on classical and quantum electron theories, and energy band structures,
- acquire knowledge on basics of semiconductor physics and its applications in various devices,
- get knowledge on the functioning of dielectric and ferroelectric materials,
- have the necessary understanding on magnetic and superconducting properties of materials,
- understand the basics of nonlinear optical materials and their applications in optical modulators.

TEXT BOOKS:

1. Kasap, S.O. “Principles of Electronic Materials and Devices”, McGraw-Hill Education, 2007.
2. Umesh K Mishra & Jasprit Singh, “Semiconductor Device Physics and Design”, Springer, 2008.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.

REFERENCES

1. Askeland, D. “Materials Science and Engineering”. Brooks/Cole, 2010.
2. Smith, W.F., Hashemi, J. & Prakash, R. “Materials Science and Engineering”. Tata McGraw Hill Education Pvt. Ltd., 2014.
3. Balasubramaniam, R. “Callister's Materials Science and Engineering”. Wiley India Pvt. Ltd., 2014.

BE8253 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING **L T P C 3 0 0 3**

OBJECTIVES:

To impart knowledge on

- Electric circuit laws, single and three phase circuits and wiring
- Working principles of Electrical Machines
- Working principle of various electronic devices and measuring instruments

UNIT I ELECTRICAL CIRCUITS **9**

Basic circuit components - Ohms Law - Kirchoff's Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis- Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem- Linearity and Superposition Theorem.

UNIT II AC CIRCUITS **9**

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits – Three phase loads - housing wiring, industrial wiring, materials of wiring

UNIT III ELECTRICAL MACHINES **9**

Principles of operation and characteristics of ; DC machines, Transformers (single and three phase) ,Synchronous machines , three phase and single phase induction motors.

UNIT IV ELECTRONIC DEVICES & CIRCUITS **9**

Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics –Field Effect Transistors – Transistor Biasing –Introduction to operational Amplifier –Inverting Amplifier – Non Inverting Amplifier –DAC – ADC .

UNIT V MEASUREMENTS & INSTRUMENTATION **9**

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - ,Classification of instruments - Types of indicating Instruments - multimeters –Oscilloscopes- – three-phase power measurements – instrument transformers (CT and PT)

TOTAL : 45 PERIODS

OUTCOMES:

Ability to

- Understand electric circuits and working principles of electrical machines
- Understand the concepts of various electronic devices
- Choose appropriate instruments for electrical measurement for a specific application

TEXT BOOKS

1. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford University Press, 2013
2. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016
3. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

REFERENCES

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3. Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009
6. N K De, Dipu Sarkar, "Basic Electrical Engineering", Universities Press (India)Private Limited 2016

BE8252 BASIC CIVIL AND MECHANICAL ENGINEERING L T P C
4 0 0 4

OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

A – OVER VIEW

UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 10

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering

Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

B – CIVIL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 10

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber - modern materials

UNIT III BUILDING COMPONENTS AND STRUCTURES 15

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations.

Civil Engineering Structures: Brickmasonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.

C – MECHANICAL ENGINEERING

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 15

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

OUTCOMES:

On successful completion of this course, the student will be able to

- appreciate the Civil and Mechanical Engineering components of Projects.
- explain the usage of construction material and proper selection of construction materials.
- measure distances and area by surveying
- identify the components used in power plant cycle.
- demonstrate working principles of petrol and diesel engine.
- elaborate the components of refrigeration and Air conditioning cycle.

TOTAL: 60PERIODS

TEXT BOOK:

1. Shanmugam Gand Palanichamy MS,"Basic Civil and Mechanical Engineering",Tata McGraw Hill PublishingCo.,NewDelhi,1996.

REFERENCES:

1. Ramamrutham S.,"Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd.1999.
2. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
3. Seetharaman S.,"BasicCivil Engineering",AnuradhaAgencies,2005.
4. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam,2000.
5. ShanthaKumar SRJ.,"Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.

GE8292 ENGINEERING MECHANICS L T P C
3 2 0 4

OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I STATICS OF PARTICLES 9+6

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 9+6

Free body diagram – Types of supports –Action and reaction forces –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 – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+6

Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 9+6

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND RIGID BODY DYNAMICS 9+6

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 45+30=75 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES:

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

GE8261 ENGINEERING PRACTICES LABORATORY L T P C
0 0 4 2

OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

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

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

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

ELECTRICAL

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

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

BE8261 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY **L T P C 0 0 4 2**

OBJECTIVE:

- To train the students in performing various tests on electrical drives, sensors and circuits.

LIST OF EXPERIMENTS:

1. Load test on separately excited DC generator
2. Load test on Single phase Transformer
3. Load test on Induction motor
4. Verification of Circuit Laws
5. Verification of Circuit Theorems
6. Measurement of three phase power
7. Load test on DC shunt motor.
8. Diode based application circuits
9. Transistor based application circuits
10. Study of CRO and measurement of AC signals
11. Characteristics of LVDT
12. Calibration of Rotometer
13. RTD and Thermistor

Minimum of 10 Experiments to be carried out :-

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to determine the speed characteristic of different electrical machines
- Ability to design simple circuits involving diodes and transistors
- Ability to use operational amplifiers

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	D. C. Motor Generator Set	2
2	D.C. Shunt Motor	2
3	Single Phase Transformer	2
4	Single Phase Induction Motor	2
5	Ammeter A.C and D.C	20
6	Voltmeters A.C and D.C	20
7.	Watt meters LPF and UPF	4
8.	Resistors & Breadboards	-
9.	Cathode Ray Oscilloscopes	4
10.	Dual Regulated power supplies	6
11.	A.C. Signal Generators	4
12.	Transistors (BJT, JFET)	-

MA8353 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
4 0 0 4

OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS 12

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

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12

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

TOTAL : 60 PERIODS

OUTCOMES :

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES:

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

ML8301 CASTING AND MACHINING PROCESSES L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on the various foundry practices being carried out in the Industry.

UNIT I PATTERN AND DIE MAKING 9

Introduction to foundry process flow, Patterns – types, functions, allowances, Selection of pattern materials, colour codes, core boxes, - considerations in Core box manufacturing, Die materials, Die design and manufacturing techniques Computer applications in Pattern and Die making

UNIT II CASTING DESIGN 9

Solidification of pure metals and alloys –shrinkage in cast metals – Design of Sprue, runner, gates –problems in design and manufacture of thin and unequal Sections, designing for directional solidification, Riser design-Chvorinov's rule, Caines, Modulus , Naval Research Laboratory methods, feeding distances – Calculations and number of Risers required, chills and feeding aids –Exothermic And Insulating sleeves Design problems of L, T, V, X and Y junctions, Computer Applications in casting design—Software for casting design.

UNIT III MOULDING AND CASTING PRACTICES 9

Sand for foundry applications – types, properties, tests. Moulding and Cores and Ingredients, Moulding and Core sand preparations, testing. Various Moulding Practices – Green Sand, CO_2 process, No Bake, Shell, Investment Casting, Permanent Moulding – Gravity, Low Pressure, High Pressure Die casting processes, Ceramic, Plaster of Paris, Centrifugal, Squeeze, Electro Magnetic and Lost Foam processes.

UNIT IV MELTING AND POURING PRACTICES 9

Principles of melting practice – Fluxing, Degasification, Modification, Deoxidation and Inoculation, Types of furnaces –Crucibles, Cupola, Oil fired furnaces, Electric furnaces – Arc and Induction types, Melting practices of Cast Iron, SG Iron, Carbon Steels, High alloy and Stainless steels, Aluminium and Copper alloys, Melt Quality control in all above processes.

UNIT V MACHINING 9

Metal cutting- chip formation, types of chips, principles of cutting –Tool Wear and failure. Principles of Turning, Drilling, Tapping, Milling, Planing, Shaping and Broaching operations

TOTAL : 45 PERIODS

OUTCOMES:

- Recognize the steps involved in the pattern and die making process
- Able to understand the various factors involved in casting design
- Have the knowledge of casting practices
- Have the knowledge of melting practices for ferrous and non ferrous alloys
- Ability to perform basic machining operations in the cast components.

TEXT BOOKS:

1. R.W.Heine, R.Loper, P.C.Rosenthal, “Principles of Metal Casting”, 2nd Edition Tata- McGraw Hill, 2001
2. P.L. Jain, “Principles of Foundry Technology”, Tata-McGraw Hill, 2003.

REFERENCES:

1. AFS Foundry Sand Handbook, American Foundrymen’s Society, Desplaines, 1963.
2. AFS Pattern Maker’s Manual-American Foundrymen’s Society, Desplaines, 1960.
3. ASM Casting Design Handbook, American Society of Metals, Metals Park, 1962.
4. Chvorinov N, Geisserei, “Theory of Solidification of castings”, , Vol.27, 1940, pp 177-225.
5. N.N. Zorev, “Metal Cutting mechanics”, Pergamon Press, Oxford, 1965.
6. R.K.Jain, S.C.Gupta, “Production Technology”, Khanna publishers, New Delhi.

ML8302 THERMODYNAMICS AND KINETICS OF MATERIALS L T P C
3 2 0 4

OBJECTIVE:

- To introduce the basic knowledge of thermodynamics required for understanding various alloy systems, phase transformations and interpreting properties

UNIT I FUNDAMENTAL CONCEPTS 9+6

Definition of thermodynamic terms; concept of states, systems, equilibrium. Equation of states, extensive and intensive properties, homogeneous and heterogeneous systems. Phase diagrams, Internal energy, heat capacity, enthalpy, isothermal, and adiabatic processes.

UNIT II INTERNAL ENERGY AND ENTROPY 9+6

First law of Thermodynamics: Relation between Heat and work, Internal energy, Enthalpy. The Second law of thermodynamics: Spontaneous process, Degree of measure of reversibility and irreversibility, Maximum work, criteria of equilibrium. Combined statement of first and second laws on thermodynamics. Statistical interpretation of entropy: Concept of microstate, most probable microstate, Thermal equilibrium, Boltzman equation

UNIT III AUXILARY FUNCTIONS AND THERMODYNAMIC POTENTIALS 9+6

Auxiliary functions: Helmholtz, Gibbs free energy, Maxwell’s equation, Gibbs-Helmholtz equations. Concept of Third law, temperature dependence of entropy, statistical interpretation of entropy, Deby and Einstein concept of heat capacity, relation between Cp and Cv, Consequences of third law. Zeroth law of thermodynamics and its applications. Thermodynamic potentials: Fugacity, Activity and Equilibrium constant. Clausius - Clayperon equation. Le Chatelier’s principle, Vant Hoff’s equation.

UNIT IV THERMODYNAMICS OF SOLUTIONS 9+6

Solutions, partial molal quantities, ideal and non-ideal solutions, Henry’s law, Gibbs - Duhem equation, regular solution, quasi-chemical approach to solution, statistical treatment. Change of standard state. Phase relations and phase rule-its applications. Free energy composition diagrams for binary alloy systems, determination of liquidus, solidus and solvus lines. Effect of pressure on phase transformation and phase equilibria.

UNIT V THERMODYNAMICS OF REACTIONS 9+6

Thermodynamics of electrochemical cells, solid electrolytes. Basic - Pourbaix diagrams. Thermodynamics of Surfaces: Adsorption isotherms, Effect of surface energy on pressure and phase transformation temperature. Thermodynamics of Defects in solids: Point defects, vacancies and interstitials in solid metals.

TOTAL: 75 PERIODS

OUTCOMES:

- To remember the fundamental concepts of thermodynamics
- Able to understand first and second laws of thermodynamics and solve related problems.
- Able to apply the basic laws and derive auxiliary functions and chemical potential.
- Able to understand the thermodynamics of solution in phase diagrams
- Able to understand and apply to solve problems related to thermodynamics of reactions.

TEXT BOOKS:

1. Boris.S.Bokstein, Mikhail I. Mendelev, David J. Srolovitz, "Thermodynamics and Kinetics in Materials science", Oxford University Press 2005.
2. David R Gaskell, “Introduction to the Thermodynamics of materials”, Taylor and Francis, Fifth edition, 2008.

REFERENCES:

1. Ahindra Ghosh, T'extbook of Materials and Metallurgical Thermodynamics", Prentice hall of India, 2003.
2. DeHoff R T, "Thermodynamics in Materials Science", McGraw Hill, New York 1993.
3. David V Ragone, “Thermodynamics of Materials - Volume-1”, John Wiley & Sons, Inc. 1995.
4. Darken LS and Gurry R W ,”Physical Chemistry of Metals”, McGraw Hill, 1987.
5. J J Moore, “Chemical Metallurgy”, Butterworth-Heinemann Ltd, 1990.
6. Prasad, Krishna Kant, Ray, H. S. and Abraham, K. P., “Chemical and Metallurgical Thermodynamics”, New Age International, 2006
7. Peter Atkins, Julio de Paula, Physical Chemistry Volume 1: Thermodynamics and Kinetics, W. H. Freeman & Company, 2010
8. Swalin R A, “Thermodynamics of solids”, John Wiley Sons Inc, third edition, 1966.
9. Thomas Engel, Philip Reid, "Thermodynamics, Statistical Thermodynamics and Kinetics", Pearson Education (LPE) 2007.
10. Upadhyaya, G. S. and Dube, R. K., “Problems in Metallurgical Thermodynamics and Kinetics”, Pergamon Press, London, 1977.

CE8395	STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr’s circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III TORSION 9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS 9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply basic equation of simple torsion in designing of shafts and helical spring
- Calculate the slope and deflection in beams using different methods.
- Analyze and design thin and thick shells for the applied internal and external pressures

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCES:

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002
2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

ML8303 MATERIALS STRUCTURE AND PROPERTIES L T P C

3 0 0 3

OBJECTIVE:

- The subject introduces the correlation of properties of materials and their structure. It revises student's knowledge of crystal structure and phase diagrams of various alloy systems. The course not only covers metals, mainly ferrous and non-ferrous alloys, but also structures and properties of ceramics, polymers, elastomers and composites.

UNIT I STRUCTURE OF SOLIDS 9

Overview of Crystal Structure – Solid Solutions-Hume Rothery Rules-Crystal Imperfections- Point Defects- Line Defects-Surface Defects-Bulk Defects-Critical nucleus size and Critical Free energy- Mechanism of Crystallisation- Nucleation-Homogeneous and Heterogenous Nucleation-Growth - Single crystal -Polycrystalline Materials - Basic principles of solidification of metals and alloys. Growth of crystals- Planar growth – dendritic growth – Solidification time - Cooling curves - Non-crystalline solids- Glass Transition Temperature.

UNIT II PHASE DIAGRAMS 9

Phase Rule –Unary System- Binary Phase diagrams- Isomorphous systems-Congruent phase diagrams - Free energy Composition curves- Construction -Microstructural changes during cooling- Tie Line- Lever Rule- Eutectic , Peritectic, Eutectoid and Peritectoid reactions- Typical Phase diagrams – Cu-Zn System – Pb-Sn system- Ag-Pt system-Iron-Iron carbide Equilibrium Diagram

UNIT III FERROUS AND NON FERROUS MATERIALS 9

Classification of steels and cast iron –Microstructure– Effect of alloying elements on steel- Ferrous alloys and their applications - Factors affecting conductivity of a metal – Electrical Resistivity in alloys – Thermal conductivity of metals and alloys - High Resistivity alloys –Some important applications of Titanium alloys, Nickel alloys, Copper alloys, Magnesium alloys and Aluminium alloys.

UNIT IV ENGINEERING CERAMICS 9

Types - Crystal Structures - Silicate Ceramics - Glasses – Glass Ceramics – Advanced ceramics-Functional properties and applications of ceramic materials –SiC, Al_2O_3, Si_3N_4– Super hard materials - Tungsten carbide and Boron nitrides – Graphene. – Applications to bio engineering

UNIT V COMMODITY AND ENGINEERING POLYMERS 9

Classification of polymer – Mechanisms of polymerisation – Copolymers – Examples- Defects in polymers- Thermoplastics - Thermosets (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)– Engineering plastics - Advanced Polymeric materials -Liquid crystal polymers - Conductive polymers – High Performance fibres– Photonic polymers- -Elastomers- Applications.

TOTAL: 45 PERIODS

OUTCOMES:

- To have the knowledge of overview crystal structures and mechanism of crystallization
- Able to understand and classify the phase diagrams.
- Able to recognize basic nomenclature, basic microstructure, associate terms with the appropriate structure / phenomena
- To have the knowledge on structure properties correlation in ceramics
- Able to understand the various polymers and its application.

TEXT BOOKS:

1. V. Raghavan, “Materials Science and Engineering”, Prentice –Hall of India Pvt. Ltd., 2007
2. William D. Callister, Jr., “Materials Science and Engineering an Introduction”, Second Edition, John Wiley & Sons, Inc., 2007.

REFERENCES:

1. Donald R. Askeland, Pradeep P. Phule, “The Science and Engineering of Materials”, 5thEdition, Thomson Learning, First Indian Reprint, 2007.
2. Kingery, W. D., Bowen H. K. and Uhlmann, D. R., “Introduction to Ceramics”, 2nd Edition, John Wiley & Sons, New York, 1976.
3. F. N. Billmayer, “Test Book of polymer science”, John Wiley & Sons, New York, 1994.
4. Sidney H. Avner, “Introduction to Physical Metallurgy”, Tata Mc-Graw-Hill Inc,2/e, 1997.
5. W. Bolton, “Engineering materials technology”, 3rd Edition, Butterworth & Heinemann, 2001.
6. William F. Smith, “Structure and Properties of Engineering Alloys”, Mc-Graw-Hill Inc., U.S.A, 2nd edition, 1993.

ML8304 PROCESSING OF IRON AND STEEL L T P C
3 0 0 3

OBJECTIVE:

- The course covers the production of iron and steel from raw material, primary processing to refinement to special steels.

UNIT I RAW MATERIALS AND BURDEN PREPARATION 9

Iron ore classification, Indian iron ores, limestone and coking coal deposits, problems associated with Indian raw materials, Iron ore beneficiation and agglomeration, Briquetting, sintering, Nodulising and pelletizing, testing of burden materials, burden distribution on blast furnace performance.

UNIT II PRINCIPLES AND PROCESSES OF IRON MAKING 9

Blast furnace parts, construction and design aspects, ancillary equipment for charging, preheating the blast, hot blast stoves, gas cleaning, Blast furnace operation, irregularities and remedies, Blast furnace instrumentation and control of furnace Compositional control of metal and slag in blast furnace, modern trends in blast furnace practice. Reduction of iron ores and oxides of iron by solid and gaseous reductions-thermodynamics and kinetics study of direct and indirect reduction, Gruner's theorem, blast furnace reactions. C-O and Fe-C-O equilibria, Rist diagrams, Ellingham diagram, material and heat balance- Sponge Iron making.

UNIT III PRINCIPLES OF STEEL MAKING 9

Development of steel making processes, physico-chemical principles and kinetic aspects of steel making, carbon boil, oxygen transport mechanism, desulphurisation, dephosphorisation, Slag Theories, slag-functions, composition, properties and theories, raw materials for steel making and plant layout.

UNIT IV STEEL MAKING PROCESSES 9

Open Hearth process- constructional features, process types, operation, modified processes, Duplexing, pre-treatment of hot metal. Bessemer processes, Side Blown Converter, Top Blown processes-L.D, L.D.A.C., Bottom blown processes, combined blown processes, Rotating oxygen processes-Kaldo and Rotor, Modern trends in oxygen steel making processes-Electric Arc and Induction furnace-constructional features. Steel Classifications and Standards- National and International.- Alloy Designation.

UNIT V STEEL LADLE METALLURGY 9

Production practice for plain carbon steels, low alloy – stainless, tool and special steels, modern developments. Secondary steel making processes, continuous steel casting process – Deoxidation and teeming practice. Principle, methods and their comparison, Killed, Rimmed and Capped steels, Degassing practices, ingot production, ingot defects and remedies. Recent trends in steel making technology.

TOTAL: 45 PERIODS

OUTCOMES:

- Able to explain the operation of burden
- Able to understand the principles and processes of iron making
- Able to understand the principles of steel making
- Able to understand the different protocols for steel making
- Able to appreciate the ladle metallurgy for alloy steel.

TEXT BOOKS:

1. Tupkary, R. H., "Modern Iron Making", 4th edition, Khanna Publishers, New Delhi.
2. Tupkary, R. H., "Modern Steel Making", 4th Edition, Khanna Publications, New Delhi.

REFERENCES:

1. Ahindra Ghosh and Amit chatterjee, "Iron Making and Steel Making – Theory and Practice", Prentice Hall of India Private Ltd., New Delhi 2008.
2. Biswas, A. K., "Principles of blast furnace iron making: theory and practice", SBA Publications, Kolkata, 1994.

3. Bashforth, G. R., “Manufacture of Iron and Steel”, Vol. I, Chapman and Hall London, 1964.
4. Bashforth, G. R., “Manufacture of Iron and Steel”, Vol.2, 3rd Edition, Chapman & Hall, London,
5. 1964.
6. Keith J. Barker “Making, Shaping and Treating of Steel”, US Steel Corporation, 11th edition, 1994.

CE8481 STRENGTH OF MATERIALS LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

LIST OF EXPERIMENTS

1. Tension test on steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL: 60 PERIODS

OUTCOME:

- The students will have the required knowledge in the area of testing of materials and components of structural elements experimentally.

REFERENCES:

1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
2. IS1786-2008 (Fourth Revision, Reaffirmed 2013), ‘High strength deformed bars and wires for concrete reinforcement – Specification’, 2008.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	UTM of minimum 400 kN capacity	1
2.	Torsion testing machine	1
3.	Izod impact testing machine	1
4.	Hardness testing machine Rockwell Vicker’s } (any 2) Brinnel	1 each
5.	Beam deflection test apparatus	1
6.	Extensometer	1
7.	Compressometer	1
8.	Dial gauges	Few
9	Le Chatelier’s apparatus	2
10	Vicat’s apparatus	2
11	Mortar cube moulds	10

ML8311 MICROSTRUCTURE ANALYSIS LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To have knowledge on the microstructures of some common types of metals and alloys and the grain size analysis of the given microstructure.

LIST OF EXPERIMENTS

1. Study of metallurgical microscope and sample preparation.
2. Quantitative Metallography – Grain Size, Nodule count, Amount of Phases.
3. Macro etching - cast, forged and welded components.
4. Microscopic examination of cast irons - Gray, White, Malleable and Nodular types
5. Microscopic examination of Plain carbon steels (low carbon, medium carbon, high carbon steels).
6. Microscopic examination of Austenitic Stainless steels and High Speed Steels.
7. Microscopic examination of banded structure in steels and welded joints.
8. Microscopic examination of Copper alloys
9. Microscopic examination of Aluminium alloys
10. Microscopic examination of Titanium alloys
11. Colour mettalography

TOTAL: 60 PERIODS

OUTCOME:

- Ability to analyse the microstructure and perform grain size, Phase, Porosity calculate from different ferrous and non-ferrous alloys.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	Mounting Press	2
2.	Belt Grinder	2
3.	polishing table with row of flat slant metal pieces to fix emery sheets	6
4.	Disc polishing equipment	6
5.	Abrasive Cutter	2
6.	Metallographic Microscope with image analyzer	2

ML8401 MECHANICAL BEHAVIOUR OF MATERIALS L T P C
3 2 0 4

OBJECTIVE

- The students having studied the basics of material structures and properties and strength of materials shall be introduced to dislocation theories of plasticity behaviour, various strengthening mechanisms and fracture mechanics. It will expose students to failure mechanisms due to fatigue and creep as well as their testing methods.

UNIT I ELASTIC AND PLASTIC BEHAVIOUR 9+6

Elastic behavior of materials - Hooke's law, plastic behaviour: dislocation theory - Burger’s vectors and dislocation loops, dislocations in the FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, dislocation climb, intersections of dislocations, Jogs, dislocation sources, multiplication of dislocations, dislocation pile-ups, Slip and twinning.

UNIT II STRENGTHENING MECHANISMS 9+6

cold working, grain size strengthening. Solid solution strengthening. martensitic strengthening, precipitation strengthening, dispersion strengthening, fibre strengthening, examples of above strengthening mechanisms from ferrous and non-ferrous systems, simple problems. Yield point phenomenon, strain aging and dynamic strain aging

UNIT III FRACTURE AND FRACTURE MECHANICS 9+6

Types of fracture, basic mechanism of ductile and brittle fracture, Griffith's theory of brittle fracture, Orowan's modification. Izod and Charpy Impacts tests, Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, determination of DBTT.

Fracture mechanics-introduction, modes of fracture, stress intensity factor, strain energy release rate, fracture toughness and determination of K_{IC}, introduction to COD, J integral.

UNIT IV FATIGUE BEHAVIOUR AND TESTING 9+6

Fatigue: Stress cycles, S-N curves, effect of mean stress, factors affecting fatigue, structural changes accompanying fatigue, cumulative damage, HCF / LCF, thermomechanical fatigue, application of fracture mechanics to fatigue crack propagation, fatigue testing machines.

UNIT V CREEP BEHAVIOUR AND TESTING 9+6

Creep curve, stages in creep curve and explanation, structural changes during creep, creep mechanisms, metallurgical factors affecting creep, high temperature alloys, stress rupture testing, creep testing machines, parametetric methods of extrapolation. Deformation Mechanism Maps according to Frost/Ashby .

TOTAL 75 PERIODS

OUTCOMES

- Ablity to understand the mechancism involved in elastic and plastic behvaiour of metals.
- Ablity to apply their knowledge of srengthening mechanism in ferrous and non ferrous sytems.
- Ablity to understand about the fundamental of fracture mechanics
- Able to apply their knowldege in real time faigue failures
- Ability to evaluate and Justify the safe use of materials for engineering application in high temperature.

TEXT BOOKS:

1. Dieter, G.E., "Mechanical Metallurgy", McGraw-Hill, SI Edition, 1995.
2. Davis. H. E., Troxell G.E., Hauck.G. E. W., "The Testing of Engineering Materials", McGraw-Hill, 1982.

REFERENCES

1. Hayden, H. W. W. G. G. Moffatt, J. Moffatt and J. Wulff, The Structure and Properties of Materials, Vol.III, Mechanical Behavior, John Wiley & Sons, New York, 1965.
2. Honey combe R. W. K., "Plastic Deformation of Materials", Edward Arnold Publishers, 1984.
3. Wulff, The Structure and Properties of Materials, Vol. III "Mechanical Behavior of Materials", John Wiley and Sons, New York, USA, 1983.
4. Suryanarayana, A. V. K., "Testing of Metallic Materials", Prentice Hall India, New Delhi, 1979.

ML8402 CORROSION AND SURFACE ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- The subject provides knowledge on various types of corrosion, their kinetics, testing and methods of protection as well as introduction to tribology.

UNIT I INTRODUCTION 12

Introduction to tribology, surface degradation, wear and corrosion, types of wear, adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication-, expressions for corrosion rate. emf and galvanic series - merits and demerits -Pourbaix diagram for iron, magnesium and aluminium. Forms of corrosion - Uniform, pitting, intergranular, stress corrosion. corrosion fatigue. dezincification. erosion corrosion, crevice corrosion - Cause and remedial measures - Pilling Bedworth ratio - High temperature oxidation-Hydrogen embrittlement - Remedial Measures.

UNIT II KINETICS OF CORROSION 8

Exchange current density, polarization - concentration, activation and resistance, Tafel equation; passivity, electrochemical behaviour of active/passive metals, Flade potential, theories of passivity, Effect of oxidizing agents

UNIT III CORROSION OF INDUSTRIAL COMPONENTS 8

Corrosion in fossil fuel power plants, Automotive industry, Chemical processing industries, corrosion in petroleum production operations and refining, Corrosion of pipelines.- wear of industrial components

UNIT IV TESTING 8

Purpose of corrosion testing - Classification - Susceptibility tests for intergranular corrosion- Stress corrosion test. Salt spray test humidity and porosity tests, accelerated weathering tests. ASTM standards for corrosion testing and tests for assessment of wear

UNIT V PROTECTION METHODS 9

Organic, Inorganic and Metallic coatings, electro and Electroless plating and Anodising - Cathodic protection, corrosion inhibitors - principles and practice - inhibitors for acidic neutral and other media. Special surfacing processes - CVD and PVD processes, sputter coating. Laser and ion implantation, Arc spray, plasma spray, Flame spray, HVOF.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to describe about the fundamental of corrosion and identify different corrosions.
- Ability to understand the theory involved in kinetics of corrosion.
- Ability to identify the corrosion types occurs in different industries.
- Ability to understand the various corrosion tests and its importance.
- Ability to apply the knowledge for selection of appropriate corrosion protection method.

TEXT BOOKS:

1. Fontana and Greene. “Corrosion Engineering”. McGraw Hill Book Co. New York. USA1986.
2. Kenneth G Budinski. “Surface Engineering for Wear Resistance”. Prentice Hall Inc.. Engelwood Cliff., New Jersey. USA 1988

REFERENCES:

1. ASM Metals Handbook. Vol.5. “Surface Engineering”. ASM Metals Park. Ohio. USA. 1994.
2. ASM Metals Handbook. Vol.l3,”Corrosion”. ASM Metals Park. Ohio. USA. 1994
3. Denny A. Jones,”Principles and Prevention of Corrosion” 2nd Edition, Prentice Hall of India,1996.
4. Raj Narayan. “An Introduction to Metallic Corrosion and its prevention”, Oxford & 1BH, New Delhi,1983.
5. Uhlig. H.H. “Corrosion and Corrosion Control”. John Wiley & Sons. New York. USA. 1985.

ML8403 NON-FERROUS METALLURGY L T P C
3 0 0 3

OBJECTIVE:

- To understand the structure, property relations of nonferrous alloys with special emphasis on engineering applications.

UNIT I COPPER AND COPPER ALLOYS 9

Methods of Production of Copper, Properties and applications of metallic copper. Major alloys of copper and designation- Brasses. Phase diagram of industrially relevant portion. Different compositions, characteristics and uses. Bronzes: Tin bronze. Composition, properties and uses. Other bronzes like Cu-Al, Cu-Si, Cu-Mn and Cu-Be alloys. Cu-Ni alloys. Typical microstructure of copper alloys.

UNIT II ALUMINIUM AND ITS ALLOYS 9

Methods of Production of Aluminium- Properties of metallic aluminium. Alloys of aluminium and designation, classification. Wrought and cast alloys. Heat treatable and nonheat treatable alloys. Age hardening of Al-Cu alloy. Al-Mg-Si, Al-Zn-Mg and Al-Li alloys. Typical microstructure of aluminium alloys. Applications of Al alloys in Automobile an Aircraft industries.

UNIT III MAGNESIUM AND TITANIUM ALLOYS 9

Methods of Production of Magnesium- properties and uses. Magnesium alloys and designation. Methods of Production of Titanium- unique characteristics of the metal- alpha, alpha+beta and beta titanium alloys- major types. Titanium aluminides – their properties and uses. Typical microstructure of magnesium and titanium alloys- Applications of Ti alloys in Aircraft, Chemical and Medical industries.

UNIT IV NICKEL AND ZINC ALLOYS 9

Methods of Production of Nickel-Properties and uses of nickel. Nickel alloys and designation – their properties and uses. Nickel aluminides. Methods of Production of Zinc-Use of zinc in corrosion protection of ferrous materials. Zinc alloys – properties and uses. Typical microstructure of nickel and zinc alloys.

UNIT V LEAD, TIN AND PRECIOUS METALS 9

Methods of Production of Lead and Tin-Major characteristics and applications of lead and tin and their alloys and designation. Low melting nature of solder alloys. Gold, silver and platinum – nobility of these metals. Engineering properties and applications of these metals and their alloys. Typical microstructure of solder alloys

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to

- To understand the structure, property relations of copper and copper alloys
- To understand the heat treatment and processing of aluminum alloys
- To understand the structure, property relations of magnesium and titanium alloys on engineering applications
- To understand the structure, property relations of nickel and zinc alloys on engineering applications
- To understand the structure, property relations of lead, tin and precious metals on engineering applications

TEXT BOOKS:

1. K.G.Budinski and M.K.Budinski, “Engineering Materials-- Properties and Selection”, PHI Learning Pvt. Ltd., New Delhi, 2009.
2. Sidney H. Avner, “Introduction to Physical Metallurgy”, Tata McGraw-Hill, 2nd Edition,1997.

REFERENCES:

1. Ahindra Ghosh, Hem Shanker Ray, “Principles of Extractive Metallurgy”, New Age International, Reprint 2001.
2. Balram Gupta, ”Aerospace Materials”, Vol. 1, 2 and 3, S. Chand and Co., New Delhi, 1996.
3. Clark and Varney, ”Physical Metallurgy for Engineers”, Affiliated East West Press, New Delhi, 1987
4. William F. Smith, ”Structure and Properties of Engineering Alloys”, McGraw Hill, USA, 1993.
5. W.H. Dennis, ”Metallurgy of the Nonferrous Metals”, Sir Isaac Pitman and Sons, London,1967.

ML8491 **POWDER METALLURGY** **L T P C**
3 0 0 3

OBJECTIVE:

- This course teaches powder preparation, characterization, compaction and sintering. This knowledge is essential to understand powder metallurgy applications in aerospace, automobile and machining materials.

UNIT I POWDER MANUFACTURE AND CONDITIONING 12

Mechanical methods Machine milling, ball milling, atomization, shotting- Chemical methods, condensation, thermal decomposition, carbonyl Reduction by gas-hydride, dehydride process, electro deposition, precipitation from aqueous solution and fused salts, hydrometallurgical method. Physical methods: Electrolysis and atomization processes, types of equipment, factors affecting these processes, examples of powders produced by these methods, applications, powder conditioning, heat treatment, blending and mixing, types of equipment, types of mixing and blending, Self-propagating high-temperature synthesis (SHS), sol-gel synthesis- Nano powder production methods.

UNIT II CHARACTERISTICS AND TESTING OF METAL POWDERS 8

Sampling, chemical composition purity, surface contamination etc. Particle size. and its measurement, Principle and procedure of sieve analysis, microscopic analysis: sedimentation, elutriation, permeability. Adsorption methods and resistivity methods: particle shape, classifications, microstructure. specific surface area. apparent and tap density. green density. green strength, sintered compact density, porosity, shrinkage.

UNIT III POWDER COMPACTION 7

Pressure less compaction: slip casting and slurry casting. pressure compaction- lubrication, single ended and double ended compaction, isostatic pressing, powder rolling, forging and extrusion, explosive compaction.

UNIT IV SINTERING 9

Stage of sintering, property changes, mechanisms of sintering, liquid phase sintering and infiltration, activated sintering, hot pressing and Hot Isostatic Pressing (HIP), vacuum sintering, sintering furnaces-batch and continuous-sintering atmosphere, Finishing operations – sizing, coining, repressing and heat treatment, special sintering processes- microwave sintering, Spark plasma sintering, Field assisted sintering, Reactive sintering, sintering of nanostructured materials.

UNIT V APPLICATIONS 9

Major applications in Aerospace, Nuclear and Automobile industries- Bearing Materials-types, Self lubrication and other types, Methods of production, Properties, Applications. Sintered Friction Materials-Clutches, Brake linings, Tool Materials- Cemented carbides, Oxide ceramics, Cermets- Dispersion strengthened materials.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and describe about various ways of producing metal powders.
- Have the knowledge of metal powder characterization.
- Ability to describe the various powder compaction process
- Ability to select appropriate sintering techniques based on the requirement.
- Ability to appreciate the role of powder metallurgy component in various fields.

TEXT BOOKS:

1. Anish Upadhya and G S Upadhaya, “Powder Metallurgy: Science, Technology and Materials, Universities Press, 2011
2. P.C.Angelo and R.Subramanian., “Powder Metallurgy: Science, Technology and Application” Prentice Hall, 2008

REFERENCES:
1. ASM Handbook. Vol. 7, “Powder Metallurgy”, Metals Park, Ohio, USA, 1990.
2. Animesh Bose., “Advances in Particulate Materials”, Butterworth - Heinemann. New Delhi, 1995.
3. Erhard Klar., “Powder Metallurgy Applications, Advantages and Limitations”, American Society for Metals, Ohio, 1983.
4. Kempton. H Roll., “Powder Metallurgy”, Metallurgical Society of AMlE, 1988.
5. R.M. German, “Powder Metallurgy and Particulate Materials Processing”, Metal Powder Industries Federation, Princeton, NJ, 2005.
6. Ramakrishnan. P., “Powder Metallurgy-Opportunities for Engineering Industries”, Oxford and IBH Publishing Co., Pvt. Ltd, New Delhi, 1987.
7. Sands. R. L. and Shakespeare. C. R. “Powder Metallurgy”, George Newes Ltd. London, 1966
8. Sinha A. K., “Powder Metallurgy”, Dhanpat Rai & Sons. New Delhi, 1982

GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth‟s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES :

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

ML8404 **PHYSICAL METALLURGY** **L T P C**
3 0 0 3

OBJECTIVE:

- Students of Materials Science and Engineering are offered an in depth study of the physical metallurgy

UNIT I PHASE TRANSFORMATION 8

Basics of thermodynamic & kinetics: equilibrium - configurational entropy - free energy of mixing - miscibility gap – chemical potential. Diffusion – uphill diffusion – downhill diffusion – atomic mechanisms of diffusion, Fick's 1st and 2nd law – solution to the diffusion equation – error functions – application of the non-steady state diffusion, spinodal decomposition

UNIT II DIFFUSION CONTROLLED PHASE TRANSFORMATION 10

Nucleation and growth - Types of nucleation - Concept of free energy during solidification - Thermodynamics of homogeneous nucleation - critical nucleus size and critical free energy change - constitutional super cooling - Extension to heterogeneous nucleation - Nucleation rate and growth rate - overall transformation rate. Concept of Activation energy - Arrhenius equation - Johnson Mehl - Avrami equation. Pearlitic transformations- spinodal decomposition

UNIT III DIFFUSIONLESS TRANSFORMATIONS 10

Martensite transformation - Definition - characteristic features of Martensitic transformation in steels - morphology of Martensite - lath and acicular martensite - Crystallography of martensitic transformation - Martensite in non-ferrous systems - Thermoelastic martensite - Shape Memory effect - Examples and applications of shape memory alloys.

UNIT IV PRECIPITATION REACTIONS 7

Precipitation from solid solutions, thermodynamic considerations, structure and property during ageing, sequence of ageing, formation of G-P zones and intermediate precipitates, theories of precipitation hardening, effect of time, temperature and alloy compositions, precipitation free zones, crystallographic aspects of transformation, coarsening kinetics.

UNIT V ANNEALING 8

Cold working and hot working. Recovery - polygonization and dislocation movements in polygonization. Recrystallisation - effect of time, temperature, strain and other variables, mechanism of nucleation and growth. Grain growth – Grain growth law, geometrical collisions, preferred orientation, secondary rerystallisation.

TOTAL : 45 PERIODS

OUTCOMES

- Ability to solve problems involving steady state and non steady state diffusion of varying degrees of complexity
- To understand the phase transformation in terms of thermodynamics.
- To understand the diffusionless transformation in ferrous and non ferrous systems.
- To understand the precipitation strengthening mechanism in terms of thermodynamics.
- To understand the structure property correlation in annealing.

TEXT BOOKS:

1. Raghavan. V., "Phase Transformations", Prentice - Hall of India, New Delhi, 2007.
2. Romesh C. Sharma, "Phase transformation in Materials", CBS Publishers & Distributors, New Delhi, 2002.

REFERENCES:

1. Anil Sinha, "Physical Metallurgy Handbook", 1st Edition, McGraw-Hill Professional; 2002.
2. George E. Totten and D. Scott MacKenzie," Handbook of Aluminum: Vol. 1: Physical Metallurgy and Processes", 1st Edition, CRC, 2003.
3. Reed Hill. R. E. "Physical Metallurgy Principles", Affiliated East West Press. New Delhi. 1992.
4. Thomas H. Courtney, "Mechanical Behaviour of Materials", McGraw-Hill Co., NY. 1990.
5. William F. Hosford, "Physical Metallurgy, Materials Engineering Series", Vol. 26, Taylor & Francis CRC Press, 2005.

ME8461 MANUFACTURING TECHNOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- Demonstration and study of the VARIOUS machines. The Main emphasis will be on a complete understanding of the machine capabilities and processes.

LIST OF EXPERIMENTS

UNIT I LATHE PRACTICE

a. Plain Turning
b. Taper Turning
c. Thread Cutting
Estimation of machining time for the above turning processes.

UNIT II DRILLING PRACTICE

a. Drilling
b. Tapping
c. Reaming.

UNIT III MILLING

a. Surface Milling.
b. Gear Cutting.
c. Contour Milling.

UNIT IV PLANNING AND SHAPING

a. Cutting Key Ways.
b. Dove tail machining.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to use different machine tools to manufacturing gears.
- Ability to use different machine tools for finishing operations
- Ability to manufacture tools using cutter grinder
- Develop CNC part programming

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1	Lathe	15 Nos.
2	Drilling Machine	1 No.
3	Milling Machine	2 Nos.
4	Planning Machine	1 No
5	Shaping Machine	2 Nos.

ML8411 FOUNDRY AND POWDER METALLURGY LABORATORY L T P C
0 0 4 2

FOUNDRY PRACTICES

OBJECTIVE:

- To make students learn about melting of metals, casting of metals and various sand testing methods.

LIST OF EXPERIMENTS

1. Determination of Average Sand grain Fineness
2. Determination of Moisture content in Sand
3. Determination of Permeability of Green Sand
4. Estimation of Active clay content in Sand
5. Loss on Ignition Test for Green moulding Sand
6. Determination of Green Compression and Shear Strength
7. Determination of Dry Compression Strength
8. Determination of Scratch Hardness.
9. Determination of Compatibility
10. Metal Casting by Green sand mould process

OUTCOMES:

- Ability to characteristic the raw materials used in Foundary
- Ability to perform Foundary practices
- Ability to casting powder
- Ability to perform powder compaction and sintering

POWDER METALLURGY

OBJECTIVE

- This laboratory course offers practical knowledge of powder metallurgy: powder synthesis, compaction and sintering.

LIST OF EXPERIMENTS

1. Powder Production by wet chemical synthesis
2. Powder size reduction by Ball Milling
3. Sieve Analysis Particle size distribution
4. Measurement of Apparent and Tap Density of Powders
5. Measurement of Flow Rate of Powders
6. Determination of optimum compaction pressure.
7. Density determination of sintered product.
8. Hardness of sintered product.
9. Preparation of porous ceramic product.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to produce and characterize the powders.
- Ability to prepare powder metallurgical compare and perform density and fracture toughness.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	Sieve shaker with set of sieves	1
2.	Infrared Moisture balance	2
3.	Permeability meter	1
4.	AFS sand rammer, base block, base permeability tube, tube filler accessory.	1
5.	Clay washer	1

6.	Muffle/Induction furnace	1
7.	Universal strength testing machine (Hydraulic)	1
8.	Scratch hardness tester	1
9	Compactablity specimen tube, Compactablity scale, Knife	1
10	Moulding box with patterns	1
11	Sand mixer	1
12	Digital top balance	1

ML8501 THEORY AND APPLICATIONS OF METAL FORMING L T P C
3 0 0 3

OBJECTIVE:

- The basic knowledge on plasticity taught in mechanical metallurgy is extended to theory and applications of metal forming. Various metal forming processes and their analysis are studied in detail.

UNIT I STRESS - STRAIN TENSOR 9

State of stress, components of stress, symmetry of stress tensor, principle stresses, stress deviator, Von Mises, Tresca Yield criteria, comparison of yield criteria, Octahedral shear stress and shear strain, Slip, twinning, Forming load calculations, Strain Rate Tensor.

UNIT II FUNDAMENTALS OF METAL FORMING 9

Classification of forming process- Mechanics of metal working, Flow stress determination, Effect of temperature, strain rate and metallurgical structure on metal working, Friction and lubrication. Deformation zone geometry, Workability, Residual stresses.

UNIT III FORGING AND ROLLING 9

Forging-Hot, Cold and Warm Forging – types of presses and hammers. Classification, Open die forging and Closed die forging, die design, forging in plane strain, calculation of forging loads, use of software for analysis - forging defects – causes and remedies, residual stresses in forging. Rolling: Classification of rolling processes, types of rolling mills, hot and cold rolling, rolling of bars and shapes, forces and geometrical relationship in rolling, analysis of rolling load, torque and power, rolling mill control, rolling defects- causes and remedies.

UNIT IV EXTRUSION AND DRAWING 9

Direct and indirect extrusion, variables affecting extrusion, deformation pattern, equipments, port – hole extrusion die, hydrostatic extrusion, defects and remedies, simple analysis of extrusion ,tube extrusion and production of seamless pipe and tube. Drawing of road, wires and tubes.

UNIT V SHEET METAL FORMING AND OTHER PROCESSES 9

Forming methods – Shearing, Fine and Adiabatic blanking, bending, stretch forming, deep drawing, defects in formed part, sheet metal formability, forming limit diagram. High velocity forming, Comparison with conventional forming, Explosive forming, Electro hydraulic, Electro Magnetic forming, Dynapark and petroforge forming.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand the plastic deformation of metals in terms of stress-strain tensor.
- Ability to understand the fundamentals and various factors contribution towards metal forming.
- Ability to understand and describe about various forging and rolling process
- Ability to identify the root causes and remedies of extruded and drawn components
- Ability to differentiate the conventional and un-conversional metal forming techniques.

TEXT BOOKS:

1. Dieter. G. E., “Mechanical Metallurgy”, Mc Graw – Hill Co., SI Edition, 1995.
2. Surender Kumar, “Technology of Metal Forming Processes”, PHI, New Delhi, 2008.

REFERENCES:

1. Avitzur, “Metal Forming – Process and Analysis”, Tata McGraw – Hill Co., New Delhi, 1977.
2. Dr.Sadhu Singh, “Theory of plasticity and Metal Forming Processes”, Khanna Publishers, 2005.
3. Kurt Lange, “Handbook of Metal Forming”, Society of Manufacturing Engineers, Michigan, USA, 1998.
4. Nagpal G. R., “Metal Forming Processes”, Khanna Pub., New Delhi, 2000
5. Shiro Kobayshi, Altan. T, "Metal Forming and Finite Element Method", Oxford University Press, 1987.
6. William F. Hosford and Robert M. Caddell, “Metal Forming Mechanics and Metallurgy”, Cambridge Press,2011.

ML8502 MATERIAL ASPECTS IN DESIGN L T P C
3 2 0 4

OBJECTIVE:

- Material Properties have to suit the purpose of an application. When designing a machine or component, many factors have to be considered and optimised. This course covers most issues for mechanical design optimisation.

UNIT I MATERIAL SELECTION IN DESIGN 9+6

Introduction – relation of materials selection to design – general criteria for selection – performance characteristics of materials – materials selection process – design process and materials selection – economics of materials – recycling and materials selection

UNIT II MATERIALS PROCESSING AND DESIGN 9+6

Role of Processing in Designing – classification of manufacturing processes – types of processing systems – factors determining process selection. Design for manufacturability, assembly, machining, casting, forging and welding

UNIT III MANUFACTURING CONSIDERATIONS IN DESIGN 9+6

Surface finish – texture – dimensional tolerances in fitting – interchangeability – selective assembly – geometric tolerance. Selection of fits and tolerances

UNIT IV MATERIALS PROPERTIES AND DESIGN 9+6

Stress – Strain diagram – design for strength, rigidity – design under static loading, variable loading, eccentric loading – stress concentration. Design examples with shaft design, spring design and C-frames.

UNIT V MATERIALS IN DESIGN 9+6

Design for brittle fracture, fatigue failure, corrosion resistance. Designing with plastics, brittle materials

TOTAL : 75 PERIODS

OUTCOMES:

- Able to understand the importance of materials selection.
- Able to design the process flow of manufacturing process.
- Ability to use different design criteria for manufacturing process.
- Ability to describe the case study on design.
- Ability to use different failure criteria for safe design of components.

TEXT BOOKS:

1. Dieter George E, Engineering Design, A materials and processing approach, 3rd Edition, McGraw Hill, 2000
2. Bhandari, "Design of Machine Elements", Tata McGraw Hill, 2006

REFERENCE:

1. CES Materials Selector, GRANTA Design and M. F. Ashby, 2007

ML8503 CHARACTERIZATION OF MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- Characterisation of materials is very important for studying the structure of materials and to interpret their properties. The students study the theoretical foundations of metallography, X-ray diffraction, electron diffraction, scanning and transmission electron microscopy as well as surface analysis.

UNIT I METALLOGRAPHIC TECHNIQUES 9

Macro examination - applications, metallurgical microscope - principle, construction and working, metallographic specimen preparation, optic properties - magnification, numerical aperture, resolving power, depth of focus, depth of field, different light sources lenses aberrations and their remedial measures, various illumination techniques-bright field , dark field, phase-contrast polarized light illuminations, interference microscopy, high temperature microscopy; quantitative metallography – Image analysis

UNIT II X-RAY DIFFRACTION TECHNIQUES 9

Crystallography basics, reciprocal lattice, X-ray generation, absorption edges, characteristic spectrum, Bragg's law, Diffraction methods – Laue, rotating crystal and powder methods. Stereographic projection. Intensity of diffracted beams – structure factor calculations and other factors. Cameras- Laue, Debye-Scherer cameras, Seeman - Bohlin focusing cameras. Diffractometer – General feature and optics, proportional, Scintillating and Geiger counters.

UNIT III ANALYSIS OF X-RAY DIFFRACTION 9

Line broadening, particle size, crystallite size, Precise parameter measurement, Phase identification, phase quantification, Phase diagram determination X-ray diffraction application in the determination of crystal structure, lattice parameter, residual stress – quantitative phase estimation, ASTM catalogue of Materials identification.

UNIT IV ELECTRON MICROSCOPY 9

Construction and operation of Transmission electron microscope – Diffraction effects and image formation, specimen preparation techniques, Selected Area Electron Diffraction, electron-specimen interactions, Construction, modes of operation and application of Scanning electron microscope, Electron probe micro analysis, basics of Field ion microscopy (FIB), Scanning Tunneling Microscope (STM) and Atomic Force Microscope(AFM).

UNIT V PRINCIPLE AND APPLICATIONS 9

Surface chemical composition- Mass spectroscopy and X-ray emission spectroscopy (Principle and limitations) - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy- Quadrapole mass spectrometer. Electron spectroscopy for chemical analysis (ESCA), Ultraviolet Photo Electron Spectroscopy (UPS), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES), Electron Energy Analysers, Secondary ion mass spectrometry - Applications. Unit meshes of five types of surface nets - diffraction from diperiodic structures using electron, Low Energy Electron Diffraction (LEED), Reflection High Energy Electron Diffraction (RHEED)-TGA.

TOTAL: 45 PERIODS

OUTCOMES:

- Able to understand the physics behind the various metallographic techniques.
- Ability to describe the principle, construction and working of XRD techniques
- Ability to analysis the X-ray diffraction data
- Ability to describe the principle, construction and working of electron microscopy.
- Ability to identify the appropriate spectroscopy technique for required information.

TEXT BOOKS:

1. Cullity, B. D.," Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000
2. Phillips V A, "Modern Metallographic Techniques and their Applications", Wiley Eastern,1971.

REFERENCES:

1. Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA,1986.
2. D. A. Skoog, F. James Leary and T. A. Nieman, "Principles of Instrumental Analysis", Fifth Edition, Saunders Publishing Co., 1998
3. Haines, P.J.," Principles of Thermal Analysis and Calorimetry", Royal Society of Chemistry (RSC), Cambridge, 2002.
4. Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996.
5. Weinberg, F., "Tools and Techniques in Physical Metallurgy", Volume I & II, Marcel and Decker,
   1970.
6. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterisation", Nineth Edition, ASM international, USA, 1986.

ML8504 HEAT TREATMENT OF METALS AND ALLOYS L T P C
3 0 0 3

OBJECTIVE:

The course covers the fundamental aspects of the theory and practice of heat treatment of metals and alloys. It provides a comprehensive understanding of the various transformation reactions associated with the changes in microstructure and property that occur due to controlled heat treatment.

UNIT I TRANSFORMATIONS IN STEELS 9

Allotropic changes in Iron, Iron-Iron carbide equilibrium diagram – transformations on heating and cooling - influence of alloying elements – general principles of heat treatment of steels – isothermal and continuous cooling transformations in steels – Time-Temperature-Transformation curves (TTT-diagrams), continuous cooling transformations – CCT-diagrams - effect of alloying additions on TTT diagrams, mechanism and kinetics of pearlitic, bainitic and martensitic transformations – precipitation hardening

UNIT II HEAT TREATMENT PROCESSES 9

Annealing- Types, Normalising, Hardening & Quenching –Mechanisms-hardenability studies – Jominy end-quench test, Grossman's experiments, tempering – Hollomon & Jaffe tempering correlations, tempering – tempered brittleness – effects of alloying elements on tempering, austempering and martempering, precipitation hardening, thermomechanical treatment, intercritical heat treatment, polymer quenching, sub-zero treatment – cryogenic quenching, patenting

UNIT III CASE HARDENING 9

Introduction, carburisation – principle – carbon potential – mechanism – application of Fick's law – depth of carburisation and its control – methods of carburising – heat treatment after carburising– structure, properties and defects in carburising, nitriding – mechanism – retained austenite – Remedy- effect of microstructure – nitriding methods, ion-nitriding and nitro-carburising, boronising, chromising, cyaniding and carbonitriding, induction and flame hardening, Laser and Electron beam hardening and welding – principles – methods – operating variables, measurement of case depth

UNIT IV FURNACES, ATMOSPHERE AND PROCESS CONTROL 9

Various heating atmosphere used for heat treatment, temperature and atmosphere control – carburising atmosphere and carbon potential measurement, Temperature Measurement Control devices – Nitriding gas atmospheres, quenching media and their characteristics, Stages of Quenching, Various Heat Treatment furnaces- Roller and Mesh type continuous furnaces- fluidised bed furnaces, vacuum furnace, cryo-chamber, cryo-treatment of steels, sealed quenched furnace, plasma equipment-Elements of Process control systems-PLC ,PID controllers and continuous monitoring systems.

UNIT V HEAT TREATMENT OF SPECIFIC ALLOYS 9

Heat treatment of special purpose steels – tool steels, high speed steels, maraging steels, SLA steels and die steels, heat treatment of cast irons – gray cast irons, white cast irons and S.G.irons, austempering of S.G.Iron, heat treatment of non-ferrous alloys – aluminium alloys, copper alloys, nickel alloys and titanium alloys, defects in heat treated parts – causes and remedies.

TOTAL: 45 PERIODS

OUTCOMES:

- Able to understand and describe the basic concepts of phase transformations in steels.
- Able to differentiate thermal and thermomechanical heat treatment processes.
- Ability to understand the various case hardening techniques and its process.
- To have the knowledge on different types of furnaces.
- Able to identify the proper heat treatment technique for required microstructure in alloy steel.

TEXT BOOKS:

1. Rajan, T. V., Sharma, C. P., Ashok Sharma., “Heat Treatment Principles And Techniques” Prentice-Hall of India Pvt. Ltd., New Delhi, 2002
2. Sydney H. Avner, “Introduction to Physical Metallurgy”, Tata McGraw Hill, New Delhi,1997.

REFERENCES:

1. ASM Hand book “Heat Treating”, Vol.4., ASM International, 1999.
2. Novikov, “Theory of Heat Treatment of Metals”, MIR Publishers, Moscow, 1978.
3. Prabhudev. K. H. “Handbook of Heat Treatment of Steels”, Tata McGraw-Hill Publishing Co., New Delhi, 1988.
4. Vijendra Singh, “Heat Treatment of Metals”, Second Edition, Standard Publishers Distributors New Delhi, 2009.

ML8505 CERAMICS AND REFRACTORY MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- To import knowledge on raw materials for ceramic, natural ceramic and engineering ceramic
- To study the characteristics and processing application of glass, refractories and engineering ceramics
- To introduce advanced ceramics and their applications.

UNIT I FUNDAMENTALS 9

Ceramic crystal structures. Phase diagram Al_2O_3-SiO2. Ceramic raw materials, Silicate and non silicate ceramics. Composition, properties, Mineralogy, Phase analysis.

UNIT II GLASS AND ITS PROCESSING 9

Introduction, classification, preparation-raw materials, mixing, charging, melting, processing. Manufacture of glass products- flat ware, hollow ware. Cullets, optical glass, optical fibers

UNIT III REFRACTORIES AND ITS PROCESSING 9

Importance and requirements, classification-fire clay, alumino silicate, silica, magnesite, forsterite, dolomite, chromite, chrome magnesite, zirconia, carbon and graphite-refractory failures.

UNIT IV CERAMIC PROCESS 9

Ceramic fabrication processes-slip forming process, plastic forming process, dry forming process, drying and finishing, firing.

UNIT V ADVANCED CERAMICS 9

Oxides, carbides, nitrides, borides, silicides, sialon carbon fibres and Carbon composites. Applications in structural, electrical and bioceramics. Ceramic coatings (thermal barriers), nuclear(cermets), process(filter, catalyst).

TOTAL:45 PERIODS

OUTCOMES:

- Ability to understand the basic of ceramics.
- Ability to understand glass and its processing.
- Ability to understand the refractories and its processing.
- Ability to understand ceramic process.
- Ability to discuss different advanced ceramics in various fields.

TEXT BOOKS:

1. James S.Reed, "Principles of Ceramic processing" John Wiley and Sons NY 1988
2. Nandi D.N.Handbook on Refractories Tata Mc Graw –Hill publishing Co New Delhi 1991
3. W.D.Kingery, H.K.Bowen and D.R. Uhlmann, "Introduction to Ceramics", 2nd Edition, by John Wiley and Sons, New York,1976

REFERENCES:

1. David W. Richerson, "Modern Ceramic Engineering", 3rd Edition, Taylor & Francis, 2005.
2. Singer, F and Singer, S.S, "Industrial Ceramics", Oxford & IBH Publishing Co., 1991
3. Tooley F.V, "Handbook of Glass Manufacture", Vol I&II, Ogden Publishing Co., NY, 1960.
4. W.Ryan, "Properties of Ceramic Raw Materials", 2nd Edition, Pergamon Press, 1978

ML8511 HEAT TREATMENT LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- This laboratory course offers practical knowledge of heat treatment applicable to Ferrous as well as Non-Ferrous materials and studies micro structural changes and hardness evaluation.

LIST OF EXPERIMENTS

1. Annealing and normalising of hardened steels
2. Spheroidisation annealing of high carbon steels
3. Effect of quenching media on hardening of steel
4. Effect of tempering temperature and time on tempering of steel
5. Effect of carbon percentage on the hardness of steel
6. Carburizing of steel
7. Case hardness depth measurements
8. Austempering treatment
9. Hardenability test – Jominy End Quench Test
10. Heat treatment of cast iron
11. Heat treatment of Stainless Steels and High speed steels
12. Heat treatment of non-ferrous alloys
13. Estimation of Ferrite

TOTAL: 60 PERIODS

OUTCOME:
Ability to perform different heat treatment operation and characterise the microstructure.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	Heat treatment furnace	2
2.	Jominy End Quench test apparatus	1
3.	Hardness testing machine	1
4.	Optical microscope with image analyzer	1

ML8512 METAL FORMING AND WELDING ANALYSIS LABORATORY L T P C
0 0 4 2

OBJECTIVE:
To acquire knowledge on basic metal forming processes by experimental study and analysis

METAL FORMING:
1. Formability of sheet metal by Ericsson cupping test
2. Thickness reduction in sheet metal rolling
3. Deep drawing for simple cup shape
4. Diameter reduction in wire drawing
5. Extrusion of cylindrical component
6. Non destructive test of metal formed components

WELDING ENGINEERING:
1. Weldability test – Bend test
2. Weld decay test
3. Macro etching analysis of welded component
4. Micro hardness analysis of welded components
5. Micro structural analysis of welded components
6. Non destructive test of welded components

TOTAL: 60 PERIODS

OUTCOMES:
- Ability to perform metal forming and welding
- Ability to evaluate the properties of processed component.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	Ericson Cup test machine	1
2.	Three roll mill	1
3.	Hydraulic press 60T	1
4.	Extrusion die – cold	1
5.	Die penetration test	1
6.	Ultrasonic flaw detector	1
7.	UTM	1
8.	Vicker Hardness tester	1
9.	Image analyser	1

ML8513 **TECHNICAL SEMINAR - I** **L T P C**
0 0 2 1

OBJECTIVES:

- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

METHOD OF EVALUATION:

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for a duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. Each student is expected to present atleast twice during the semester and the student is evaluated based on that. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report. A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

TOTAL : 30 PERIODS

OUTCOMES:

- Ability to review, prepare and present technological developments
- Ability to face the placement interviews

ML8601 **POLYMER PROCESS ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVE:

- The subject exposes students to the basics of polymer, polymerisation, condensation, their properties and overview of manufacturing.

UNIT I POLYMERIZATION **9**

Fundamentals of polymers – monomers – functionality - Classification – characterization –. Types of Polymerization: cationic polymerization – anionic polymerization – coordination polymerization – free radical polymerization. Copolymerization concepts - Simple condensation reactions – Extension of condensation reactions to polymer synthesis – functional group reactivity. Polycondensation – kinetics of polycondensation - Carother's equation – Linear polymers by polycondensation – Interfacial polymerization – crosslinked polymers by condensation – gel point.

UNIT II MOLECULAR WEIGHTS OF POLYMERS **9**

Number average and weight average molecular weights – Degree of polymerization – molecular weight distribution – Polydispersity – Molecular weight determination- Different methods – Gel Permeation Chromatography

UNIT III TRANSITIONS IN POLYMERS **9**

First and second order transitions – Glass transition, Tg – multiple transitions in polymers – experimental study – significance of transition temperatures. Crystallinity in polymers – effect of crystallization – factors affecting crystallization, crystal nucleation and growth – Relationship between Tg and Tm – Structure–Property relationship.

UNIT IV SOLUTION PROPERTIES OF POLYMERS **9**

Size and shape of the macromolecules – Solubility parameter – polymer/solvent interaction parameter – temperature – size and molecular weight. Solution properties of polymers. Importance of Rheology – Newtonian and Non-Newtonian flow behaviour – Polymer melts Rheology.

UNIT V POLYMER PROCESSING 9

Overview of Features of Single screw extruder –Tubular blown film process - Coextrusion.- Injection Moulding systems – Compression & Transfer Moulding - Blow Moulding – Rotational Moulding – Thermoforming – Vacuum forming -Calendering process – Fiber Spinning process – Structural Foam Moulding – Sandwich Moulding. Processing for Thermosets - Reaction Injection Moulding & Reinforced Reaction Injection Moulding.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to develop structure – property relationship in polymer.
- Ability to understand the effect of molecular weight contribution towards polymer and its measurement techniques.
- Able to differentiate amorphous and crystallization in polymers.
- Ability to describe the polymer rheology.
- Ability to select appropriate polymer processing techniques for products.

TEXT BOOKS:

1. G. Griskey, “Polymer Process Engineering”, Chapman & Hall, New York, 1995.
2. D. H. Morton Jones, “Polymer Processing”, Chapman & Hall, New York, 1995.

REFERENCES:

1. Billmayer Jr. and Fred. W., “Textbook of Polymer Science”, WileyTappers, 1965.
2. David, J. W., “Polymer Science and Engineering”, Prentice Hall,1971.
3. Schmidt, A. K. and Marlies, G. A., “High Polymers - Theory and Practice”, McGraw Hill,1948.
4. McKelvey, J. M., “Polymer Processing”, John Wiley, 1962.
5. Rodriguez, F., Cohen.C., Oberic.K and Arches, L.A., Principles of Polymer Systems, 5th Edition, Taylor and Francis, 2003.
6. Crawford R.J, "Plastics Engineering" 3rd Edition, Pergamon Press, London 1987

ML8602 COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- Composites are a relatively new class of materials. In this course the students learn about the benefits gained when combining different materials into a composite. The Motive is to make the students to understand different processing methods, issues, properties and testing methods of different composite materials

UNIT I INTRODUCTION TO COMPOSITES 8

Fundamentals of composites - need for composites – enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

UNIT II POLYMER MATRIX COMPOSITES 12

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. PMC processes - hand lay up processes – spray up processes – compression moulding – reinforced reaction injection moulding - resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.-applications of PMC in aerospace, automotive industries

UNIT III METAL MATRIX COMPOSITES 9

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement - volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process - diffusion bonding – stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties- applications of MMC in aerospace, automotive industries

UNIT IV CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITES 9

Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics - need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). applications of CMC in aerospace, automotive industries- Carbon /carbon composites – advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol-gel technique- Processing of Ceramic Matrix composites.

UNIT V MECHANICS OF COMPOSITES 7

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations.
Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

TOTAL: 45 PERIODS

OUTCOMES:

- Able to understand and describe the basic concept and classification of composite.
- To acquire the knowledge in polymer matrix composites and its processing methods.
- To acquire the knowledge in metal matrix composites and its processing methods.
- To acquire the knowledge in ceramics matrix composites and its processing methods.
- Use of Mathematical techniques to predict the macroscopic properties of different Laminates

TEXT BOOKS:

1. Mathews F. L. and Rawlings R. D., "Composite Materials: Engineering and Science", 1st Edition, Chapman and Hall, London, England, 1994.
2. Chawla K. K., "Composite materials", Second Edition, Springer – Verlag, 1998.

REFERENCES:

1. Clyne, T. W. and Withers, P. J., "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.
2. Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
3. Sharma, S.C., "Composite materials", Narosa Publications, 2000.
4. Broutman, L.J. and Krock,R.M., " Modern Composite Materials", Addison-Wesley, 1967.
5. ASM Hand Book, "Composites", Vol.21, ASM International, 2001.

MG8691 INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To provide an opportunity to learn basic management concepts essential for business..

UNIT I INTRODUCTION 9

Management - Definition **–** Functions **–** Evolution of Modern Management **–** Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization **–** Individual Ownership **–** Partnership **–** Joint Stock Companies **–** Co-operative Enterprises **–** Public Sector Undertakings, Corporate Frame Work **–** Share Holders **–** Board of Directors **–** Committees **–** Chief Executive **–**Trade Union.

UNIT II FUNCTIONS OF MANAGEMENT 9

Planning **–** Nature and Purpose **–** Objectives **–** Strategies **–** Policies and Planning Premises **–** Decision Making **–** Organizing **–** Nature and Process **–** Premises **–** Departmentalization **–** Line and staff **–** Decentralization **–** Organizational culture, Staffing - selection and training **–** Placement **–** Performance appraisal **–** Career Strategy **–** Organizational Development. Leading **–** Managing human factor **–** Leadership **–** Communication, Controlling - Process of Controlling **–** Controlling techniques, productivity and operations management **–** Preventive control, Industrial Safety.

UNIT III ORGANIZATIONAL BEHAVIOUR 9

Definition **–** Organization **–** Managerial Role and functions **–** Organizational approaches, Individual behaviour **–** causes **–** Environmental Effect **–** Behavior and Performance, Perception **–** Organizational Implications. Personality **–** Contributing factors - Dimension **–** Need Theories **–** Process Theories **–** Job Satisfaction, Learning and Behavior **–** Learning Curves, Work Design and approaches.

UNIT IV GROUP DYNAMICS 9

Group Behavior **–** Groups **–** Contributing factors **–** Group Norms, Communication **–** Process **–** Barriers to communication **–** Effective communication, leadership **–** formal and informal characteristics **–** Managerial Grid **–** Leadership styles **–** Group Decision Making **–** Leadership Role in Group Decision, Group Conflicts **–** Types **–** Causes **–** Conflict Resolution **–** Inter group relations and conflict, Organization centralization and decentralization **–** Formal and informal **–** Organizational Structures **–** Organizational Change and Development **–** Change Process **–** Resistance to Change **–** Culture and Ethics.

UNIT V MODERN CONCEPTS 9

Management by Objectives (MBO), Management by Exception (MBE), Strategic Management - Planning for Future direction **–** SWOT Analysis **–** Information technology in management **–** Decisions support system **–** Business Process Re-engineering (BPR) **–** Enterprises Resource Planning (ERP) **–** Supply Chain Management (SCM) **–** Activity Based Management (ABM).

TOTAL : 45 PERIODS

OUTCOME:

- Students gain knowledge on the basic management principles to become management (s) professional.

TEXT BOOKS

1. Herald Knottz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill Education Pvt. Ltd., 2010.
2. Stephen P. Robbins, "Organization Behaviour", Pearson Education Inc., 13 edition, 2010.

REFERENCES:

1. Joseph J, Massie, "Essentials of Management" Prentice Hall of India Pvt. Ltd. 1985.
2. Ties, AF, Stoner and R.Edward Freeman, "Management" Prentice Hall of India Pvt. Ltd. New Delhi 110 011, 1992
3. Tripathi. P.C. & P.N. Reddy, "Principles of Management", Tata McGraw Hill, 2006.

ML8603 **WELDING METALLURGY** **L T P C**
3 0 0 3

OBJECTIVE:

- Welding is one of the most important fabrication processes in industry and requires both theoretical understanding and experience of materials used in industry. This can be achieved in this course.

UNIT I WELDING METALLURGY PRINCIPLES 9

Thermal cycles in welding: basic heat transfer equations, temperature distributions and cooling curves, dependence of cooling rate on heat input, joint geometry, preheat and other factors. Comparison of welding processes based on these considerations.

UNIT II PHYSICAL METALLURGY OF WELDING 9

Welding of ferrous materials: Iron - carbon diagram, TTT and CCT diagrams related to welding, effects of steel composition, formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.

UNIT III WELDING OF ALLOY STEELS 9

Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron.

UNIT IV WELDING OF NON-FERROUS METALS 9

Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions.

UNIT V DEFECTS AND WELDABILITY 9

Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, testing of weldability.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to select and design welding materials.
- To understand the physical metallurgy behind welding
- Able to overcome on welding of steel and cast iron difficulties.
- Able to understand the problems in welding of non ferrous materials and its solutions.
- Able to identify the defects in welded joints and its root causes.

TEXT BOOKS:

1. Linnert. G. E. “Welding Metallurgy”. Vol. 1 and 2. 4th Edition. A W S. USA, 1994.
2. Lancaster J. F. “Metallurgy of Welding”, 4th Londre: George Allen & Unwin.1987.

REFERENCES:

1. “AWS Welding Hand book”, 8th Edition, Vol-1,“Welding Technology”, 1998.
2. Henry Granjon,“Fundamentals of Welding Metallurgy”, Abington Pub, 1991
3. Robert W. Messler, “Principles of Welding: Processes, Physics, Chemistry, and Metallurgy”, Wiley, 1999.
4. Saferian D. “The Metallurgy of Welding”. Chapman and Hall, UK, 1985.
5. Sindo Kuo,“ Welding Metallurgy”, John Wiley & Sons, 2003

ML8604 NON DESTRUCTIVE MATERIALS OF EVALUATION L T P C
3 0 0 3

OBJECTIVE:

- To study and understand the various Nondestructive Evaluation and Testing methods, theory and their industrial applications.

UNIT I INTRODUCTION TO NDT 7

NDT Versus Mechanical testing, Need for Nondestructive testing Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided- Standards

UNIT II SURFACE NDE METHODS 8

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Checking quality of consumables. Magnetic Particle Testing- Theory of magnetism, magnetization methods, pie gages, types of MPT equipment, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 10

Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and techniques-pulsed thermography, lock in thermography, applications.
Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, reference blocks, Types of arrangement, Types of applications – coating thickness, defect detection, metal identification, advantages, Limitations, Interpretation/Evaluation.

UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 10

Ultrasonic Testing-Principle, testing equipment, controls, probes -, straight beam and angle beam, T-R probes, construction, types, data representation, A-Scan, B-Scan, C-Scan – through transmission and pulse-echo techniques. Calibration blocks and reference blocks, Distance Amplitude Correction (DAC), Phased Array Ultrasound, Time of Flight Diffraction.
Acoustic Emission Technique –Principle, AE parameters, instrumentation, Applications.

UNIT V RADIOGRAPHY (RT) 10

Principle and physics behind radiography - radiation interaction with matter, image formation, inverse square law, radiographic equivalence, radiographic attenuation, half value thickness, tenth value thickness, radioactivity, half life; Radiation sources – X-ray and gamma ray – equipment, construction, operation; Films –types, film speeds, film processing; Film characteristics – graininess, density, speed, contrast, characteristic curves, penetrameters, exposure charts; Radiography techniques –Digital radiography, computed radiography and computed tomography, Safety in radiography.

TOTAL: 45 PERIODS

OUTCOMES:

- Able to understand the requirement of NDT in industries.
- Ability to test surface defects using liquid penetrant test.
- Ability to interpret eddy current test result.
- Able to describe ultrasonic and acoustic emission testing
- Able analyze the radiography testing result.

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st Revised Edition, New Age International Publishers, 2010

REFERENCES:

1. ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.
3. Charles, J. Hellier," Handbook of nondestructive evaluation", McGraw Hill, New York 2001.
4. Paul E Mix, "Introduction to nondestructive testing: a training guide", 2nd Edition, Wiley, New Jersey, 2005
5. R. Halmshaw, "Introduction to the Non-Destructive Testing of Welded Joints" – 2nd Edition, Woodhead Publishing, 1997.

ML8611 COMPOSITE MATERIALS LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- Students learn the fabrication processes of different composite materials and the mechanical characterization of these materials.

LIST OF EXPERIMENTS:

1. Preparation of Continuous Fiber reinforced Polymer Composites
2. Preparation of Dis-Continuous Fiber reinforced Polymer Composites
3. Study of Tensile strength and young's modulus of FRP composites
4. Study of Flexural strength of FRP composites
5. Study of Hardness of FRP composites
6. Study of drop weight impact testing
7. Preparation of Al-SiC composites by stir casting method
8. Study of microstructure, hardness and density of Al-SiC composite
9. Study of Tensile strength of Al-SiC composites
10. Environmental Testing (Humidity and temperature)

TOTAL : 60 PERIODS

OUTCOME:

- Ability to prepare and characterise different components materials

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	Tensile testing machine	1
2.	Hardness testing machine (Knoop, Brinell)	1
3.	Drop weight impact tester	1
4.	Stir casting set up	1
5.	Optical microscope	1
6.	Humidifier	1
7.	Hot testile testing machine	1
8.	Weighting balance	1
9.	Flexural testing machine	1

ML8612 **MATERIALS CHARACTERIZATION LABORATORY** **L T P C 0 0 4 2**

OBJECTIVE:

- This laboratory gives practical exposure characterization techniques and teaches to interpret results with knowledge gained from the theory subject on characterization of materials.

LIST OF EXPERIMENTS:

1. Identification of phase
2. Cell parameters calculation
3. Biphasic composition weight percentage based on X-ray diffraction
4. Nanosize determination
5. SEM topography
6. Indexing of selected area electron diffraction pattern
7. Image analysis of microstructures

TOTAL : 60 PERIODS

OUTCOME

- Ability to characteristic the material using advanced characterization tools.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	Metallographic Microscope with image analyzer	10
2.	X-ray Diffractometer (XRD)	1
3.	Scanning Electron Microscope (SEM)	1
4.	Transmission Electron Microscope (TEM)	1

Note:

1. SEM, XRD, TEM equipments and related hardware are not mandatory. Only the data, graphs, images taken from these equipments are needed for conducting this laboratory. Demonstration of equipments may be done by visit to Research & Development centres or educational institutes.

HS8581 **PROFESSIONAL COMMUNICATION** **L T P C 0 0 2 1**

OBJECTIVES: The course aims to:

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

UNIT I

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- activities to improve GD skills

UNIT IV

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

TOTAL : 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

Make effective presentations
Participate confidently in Group Discussions.
Attend job interviews and be successful in them.
Develop adequate Soft Skills required for the workplace

Recommended Software

1. Globearena
2.Win English

REFERENCES:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.
3. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

GE8077 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES 9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOME:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO 9001-2015 standards

ML8701 COMPUTER APPLICATIONS IN MATERIALS SCIENCE L T P C
3 0 0 3

OBJECTIVE:

- Computer applications have become important to solve, approximate, interpret and visualize problems in Materials Science. After reviewing the mathematical foundation, applications in Materials Science are introduced.

UNIT I INTRODUCTION 9

A Brief History of the Finite Element Method - Basic Steps in the Finite Element Method- Theory vs Computer Applications of FEA. Matrices - basic matrix problems, Simultaneous linear algebraic equations –Basic problems. Nodes-Elements-Types of Elements- Element Characteristics matrix-Linear spring and Heat Flow using Direct approach for 2node 1D element, Element Assembly – Solving – Boundary Conditions. Awareness about the software used for analysis of FEM.

UNIT II ANALYSIS OF ONE DIMENSIONAL PROBLEM 9

Discretization – Local and global Numbering- Approximate functions- Coordinate systems-Shape Functions – Two node Linear: bar and link element. Trusses & Beams– Finite element formulation - Solid Mechanics problems on Bar ,Shaft, Stepped Shaft , Tapper shaft and Trusses - Heat Transfer Problems on Fin and Composite Wall.

UNIT III ANALYSIS OF TWO DIMENSIONAL PROBLEMS 9

Introduction- Plane Stress – Plane Strain - Triangular Elements - Coordinate System – Shape Function -Finite Element Formulation – Rectangular Elements -Coordinate System – Shape Function -Finite Element Formulation- Axisymmetric Elements- Coordinate System – Shape Function -Finite Element Formulation. Elements used by any finite element analysis (FEA) software to solve simple Structural Problems. Formulation With Triangular Elements – conduction Elements used by any FEA software – simple 2D Heat Transfer Problems.

UNIT IV DYNAMIC ANALYSIS 9

Introduction – Basic Equations in Vibration –Types of Vibration- Mass matrices – Undamped free vibration -Finite Element Formulation (2node 1D element) – Vibration Analysis- Eigen value &Eigen vector problem- Problems on Bar and Rod , Beams with Single Degree of Freedom – Exercise using any FEA software.

UNIT V SELECTED APPLICATIONS IN MATERIALS SCIENCE 9

Materials modeling and simulation across the length scale and applications: Modeling property prediction through first principle calculations. Monte Carlo Method for simulating nucleation and growth of grains in materials, Molecular Dynamics – General Principles. Introduction into CALPHAD approach. Introduction to phase field modeling. Awareness about the software used various modeling and simulations.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to use Computational Techniques the Materials Engineering
- Use of Mathematical equation to predict the properties of materials

TEXT BOOKS:

1. Erdogan Madenci and Ibrahim Guven, The Finite Element Method And Applications In Engineering Using ANSYS®, *The University of Arizona* 2006, Springer Science Business Media, LLC
2. Robert D.Cook, Finite Element Modeling for Stress Analysis, John Wiley & Sons, Inc. 1995.
3. Saeed Moaveni, “Finite Element Analysis Theory and Application with ANSYS”, Prentice Hall, Upper Saddle River, New Jersey, 2008

REFERENCES:

1. Bathe K.-J. and Wilson E. L. Numerical Methods in Finite Element Analysis. – Prentice-Hall, Inc., 1976.
2. Dierk Raabe, Computational Materials Science-The Simulation of Materials Microstructures and Properties, WILEY-VCH Verlag GmbH. 1998.
3. Evgeny Barkanov, Introduction to the Finite Element Method, Riga Technical University, 2001.
4. Rao S. S. The Finite Element Method in Engineering. – Pergamon Press, 1989.
5. Sigerlind L. J. Applied Finite Element Analysis. – John Wiley and Sons, Inc., 1976.
6. Zienkiewicz O. C. and Cheung Y. K. The Finite Element Method in Structural and Continuum Mechanics. – McGraw-Hill: London, 1967.

ML8702 NANOSTRUCTURE MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- To motivate the students to understand the evolution of nanomaterials in the scientific era and make them to understand different processing methods, properties of nanomaterials for the future engineering applications

UNIT I INTRODUCTION TO NANOMATERIALS 7

Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials- historical development of nanomaterials – Nanomaterials classification (Gleiter's Classification) – properly changes done to size effects, Hall – petch, inverse Hall- petch effects - polymeric nanostructures

UNIT II ZERO DIMENSIONAL NANOMATERIALS 10

Nanoparticles – Properties – Processing – Liquid state processing - Sol-gel process, wet chemical synthesis – Vapour state processing – PVD, CVD, Aerosol processing, solid state processing – mechanical, mechanochemical synthesis – Application of nanoparticle. Quantum Dots – Quantum confinement – Pauli's Exclusion Principle – Processing – Optical lithography – MOCVD – Droplet epitaxy - Applications.

UNIT III ONE DIMENSIONAL NANOMATERIALS 10

Carbon nanotubes – Old and new forms of carbon – Structure of CNT and classification – Processing – Solid carbon based production techniques – Gaseous carbon based production technique - growth mechanisms – Applications.Nanowire – processing – Laser ablation – Oxide assisted growth – carbo thermal reactions – Thermal evaporation – Temperature based synthesis – Electro spinning – Vapour–Solid growth (VS growth) - vapour – liquid – solid growth (VLS technique) – Applications.

UNIT IV SUPER HARD COATINGS AND BULK NANOSTRUCTURED MATERIALS 9

Superhard coating – types – characteristics – thermal stability – case studies $nc-TiN/a-Si_3N_4$ coating) – Applications. Bulk nanostructure formation – Equal Channel Angular pressing (ECAP) – High Pressure Torsion(HPT), Accumulative roll bending – Reciprocating extrusion - compression, cyclic close die forging – Repetitive corrugation and straightening – Grain refinement mechanisms.

UNIT V CHARACTERIZATION OF NANOMATERIALS 9

Nano indentation – Types of nanoindenter – Force actuation-Displacement measurement-factors affecting nanoindentation- Atomic Force Microscope (AFM) – Scanning Tunneling Microscope (STM) – Electrostatic Force Mode (EFM) – Magnetic Force Mode (MFM) – Scanning Electron Microscope (SEM) – Transmission Electron Microscope (TEM).

TOTAL: 45 PERIODS

OUTCOMES:

- Able to understand and describe the development of nanomaterials and its classification.
- Able to understand the synthesis routes of zero dimensional nanomaterials.
- Able to understand the advantages and limitation of various synthesis routes of CNT.
- Ability to apply grains size strengthening mechanism concepts in bulk nanostructure formation.
- To have the knowledge of hardness measurements of nanomaterials.

TEXT BOOKS:

1. Carl C. Koch (ed.), "Nanostructured Materials", Processing, Properties and Potential Applications, Noyes Publications, Norwich, New York, U.S.A.,2002.
2. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd Edition, 2007.

REFERENCES:

1. Bamberg, D., Grundman, M. and Ledentsov, N.N., "Quantum Dot Heterostructures", Wiley, 1999.
2. Charles P. Poole Jr., Frank J. Ownes, 'Introduction to Nanotechnology", Wiley Interscience, 2003.
3. G Timp (ed), "Nanotechnology", AIP press/Springer, 1999.
4. K.A. Padmanabhan and S. Balasivanandha Prabu, 'On the Origins of Conflict in the Experimental Results Concerning the Mechanical Properties of Ultra-Fine Grained and Nanostructured Materials: Effects of Processing Routes and Experimental Conditions', Adv.Mech.Properties and Deform. Mechanism of Bulk Nanostr.Mat, Trans Tech Publication,UK, ISBN-13::978-3-03785-105-0, pp.3-54,
5. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, New Delhi, 2003.
6. G. Wilde, "Nanostructured Materials', Elsevier, 2008.

MF8761	COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

LIST OF EXPERIMENTS:

A. SIMULATION

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables 2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using software

B. ANALYSIS

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi **–** symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

TOTAL: 60 PERIODS

OUTCOME:

- To train the students to make use of software for simulation and analysis for various applications in the field of manufacturing engineering.

TEXT BOOKS:

1. The Mathworks, Inc, **"**The student Edition of Matlab**"**, student Edition, The MATLAB curriculum series, 1997
2. Rudra Pratap, **"**Getting started with MATLAB**"**, 1st Edition, Oxford University Press, 2010

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

Finite Element Analysis Software, MATLAB Software, Computers with necessary accessories.

MF8711 **TECHNICAL SEMINAR - II** **L T P C**
0 0 2 1

OBJECTIVE:

- To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

METHOD OF EVALUATION:

The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics

TOTAL : 30 PERIODS

OUTCOME:

- Ability to understand and comprehend any given problem related to mechanical engineering field.

ML8712 **MATERIAL DESIGN PROJECT** **L T P C**
0 0 4 2

OBJECTIVE

The main objective is to impart hands on training to the students in the fabrication of one or more component of a complete working model, which has been designed by them. The transfer of concepts studied in the Materials Science Programme to a practical application is important.

Students get familiarized in the field of material synthesis or processing, metal joining or casting or forming, or mechanical behavior of materials or material characterization or material testing and analysis. The project can also focus on the selection and optimization of materials in design of on a purely material oriented project such as the development and characterization of an alloy.

The students may be grouped in small groups and work under a project supervisor. The components to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group, which will be evaluated by a Committee which will be constituted by the Head of the Department

TOTAL : 60 PERIODS

OUTCOME:

Ability to present the microstructure and provide Processing – Structure- Property correlation for the materials.

MF8713 **INDUSTRIAL/ FIELD TRAINING** **L T P C**
0 0 0 1

OBJECTIVE:

This course is mandatory to gain exposure to applications in industry.

The students have to undergo practical industrial training for six weeks (during vacation at the end of VI semester) in recognized industrial establishments. At the end of the training they have to submit a report with following information:

Profile of the Industry

1. Product range
2. Organization structure
3. Plant layout
4. Processes/Machines/Equipment/devices
5. Personnel welfare schemes
6. Details of the training undergo
7. Projects undertaken during the training, if any
8. Learning points.
9. End Semester examination will be a Viva-Voce Examination.

OUTCOME
Ability to present the Industrial activities and know about process/product/magnet techniques under in the Industries.

ML8811 PROJECT WORK L T P C
0 0 20 10

OBJECTIVE:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOME:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

ML8001 MODERN MANUFACTURING PROCESS L T P C
3 0 0 3

OBJECTIVE:

- To understand material removal by using various forms of energy and machining new materials and complex parts with high accuracy by using non-traditional machining.

UNIT I INTRODUCTION 7
Need of Non-Traditional Machining Processes – Classification Based on Energy, Mechanism, source of energy, transfer media and process - Process selection-Based on Physical Parameters, shapes to be machined, process capability and economics – Overview of all processes.

UNIT II MECHANICAL PROCESS 10
Ultrasonic Machining: Principle- Transducer types – Concentrators - Abrasive Slurry - Process Parameters – Tool Feed Mechanism – Advantages and Limitations – Applications. Abrasive Jet Machining: Process- Principle – Process Variables – Material Removal Rate - Advantages and Limitations – Applications. Water Jet Machining: Principle – Process Variables - Advantages and Limitations – Practical Applications – Abrasive water jet machining process.

UNIT III ELECTRICAL DISCHARGE MACHINING 10
Electrical Discharge Machining: Mechanism of metal removal – Dielectric Fluid – Flushing methods - Electrode Materials - Spark Erosion Generators – Electrode Feed System – Material Removal Rate – Process Parameters – Tool Electrode Design – Tool wear Characteristics of Spark Eroded Surfaces- Advantages and Limitations – Practical Applications. Electrical Discharge Wire Cut and Grinding: Principle – Wire Feed System - Advantages and Limitations – Practical Applications

UNIT IV CHEMICAL AND ELECTRO CHEMICAL MACHINING 10

Chemical Machining: fundamentals, Principle –classification and selection of Etchant -chemical milling, Engraving, Blanking - Advantages and limitations – Applications. Electro Chemical Machining: Electro-chemistry of the process-Electrolytes - Electrolyte and their Properties – Material Removal Rate – Tool Material – Tool Feed System – Design For Electrolyte Flow – Process Variables - Advantages and Limitations – Applications - Electro Chemical Grinding: Honing, cutting off, Deburring and turning.

UNIT V HIGH ENERGY MACHINING PROCESS 8

Electron Beam Machining: Principle –Generation and control of electron beam-Advantages and Limitations – Applications. Laser Beam Machining: Principle –Solid and Gas Laser Application – Thermal Features of LBM - Advantages and Limitations – Applications. Ion Beam Machining: Equipment – process characteristics - Advantages and Limitations – Applications. Plasma Arc Machining: Principle –Gas mixture– Types of Torches – Process Parameters - Advantages and Limitations – Applications. Ion Beam Machining – Principle – MRR – advantages, limitation, applications.

TOTAL : 45 PERIODS

OUTCOMES:

- Describe the modern manufacturing process with respect to productivity economic
- Explain the trends in development of manufacturing process selection of suitable process for metal cutting and non-traditional manufacturing.

TEXT BOOKS:

1. P.C Pandey And H.S. Shan, “Modern Machining Process”, Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 2007
2. V.K. Jain, “Advanced Machining Process”, Allied Publishers Pvt Limited 2007

REFERENCES:

1. Amithaba Bhattacharyya, “New Technology”, The Institution Of Engineers, India
2. HMT Bangalore, "Production Technology”, Tata Mc Graw–Hill Publishing Company Limited, New Delhi, 2006.
3. Hassan El – Hofy “Advanced machining Processes” MC Graw-Hill, 2005.

ML8002 BIO AND SMART MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- To study applications of materials in biomedical engineering and special materials for actuators, sensors, etc.

UNIT I INTRODUCTION 9

Intelligent / Smart materials – Functional materials – Polyfunctional materials – Structural materials, Electrical materials, bio-compatible materials. – Intelligent biological materials – Biomimetics – Wolff’s Law – Biocompatibility – Material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – host response: the inflammatory process – coagulation and hemolysis – in vitro and in vivo evaluation of biomaterials.

UNIT II ELECTRO-RHEOLOGICAL AND PIEZOELECTRIC MATERIALS 9

The principal ingredients of smart materials –microsensors- hybrid smart materials - an algorithm for synthesizing smart materials – active, passive reactive actuator based smart structures-suspensions and electro-rheological fluids - Bingham body model – principal characteristics of electro-rheological fluids – charge migration mechanism for the dispersed phase – electro-rheological fluid domain – fluid actuators- design parameter – application of Electo-rheological fluids – Basics, Principles and instrumentation and application of Magnetorheological fluids – Piezoelectric materials: polymers and ceramics, mechanism, properties and application. Introduction to electro-restrictive and magneto-restrictive materials

UNIT III SHAPE MEMORY MATERIALS 9

Nickel – Titanium alloy (Nitinol) – Materials characteristics of Nitinol – martensitic transformations – austenitic transformations – thermoelastic martensitic transformations– classification of SMA alloys- mechanism of magnetic SMA – applications of SMA – continuum applications of SMA fasteners – SMA fibers – reaction vessels, nuclear reactors, chemical plant, etc. – micro robot actuated by SMA – SMA memorization process (Satellite Antenna Applications) SMA blood clot filter – Impediments to applications of SMA – Shape memory polymers– mechanism of shape memory-Primary moulding – secondary moulding – types and applications.

UNIT IV ORTHOPAEDIC AND DENTAL MATERIALS 9

Bone and teeth composition, formation and properties – bioresorbable, bioinert, bioactive materials - temporary fixation devices – joint replacement – biomaterials used in bone and joint replacement metals and alloys- Fillings and restoration materials – Materials for oral and maxillofacial surgery – dental cements and dental amalgams – dental adhesives- bone tissue engineering.

UNIT V APPLICATIONS OF BIO MATERIALS FOR CARDIOVASCULAR OPTHALMOLOGY AND SKIN REGENERATION 9

Blood clotting – blood theology– approaches to thrombo resistance materials development – blood vessels – The heart – aorta and valves – geometry of blood circulation – cardiac pacemakers – blood substitutes – extracorporeal blood circulation devices.The lungs – vascular implants: vascular graft, cardiac valve prostheses, card– Biomaterials in opthalmology –skin grafts -connective tissue grafts – tissue adhesives – drug delivery methods and materials.

TOTAL: 45 PERIODS

OUTCOMES:

- Use of Bio materials for cardiovascular Opthalmology and Skin Regeneration
- Use of Bio materials for Dental & Bone application
- Use of shape memory alloys in engineering application
- Explain the characteristics of Bio and smart materials
- Use of smart materials as sensors, actuators.

TEXT BOOKS:

1. M. V. Gandhi and B. S. Thompson, “Smart Materials and Structures”, Chapman and Hall, London, First Edition, 1992.
2. Sujata V., Bhat., “Biomaterials”, Narosa Publication House, New Delhi, 2002

REFERENCES:

1. Buddy D. Ratner (Editor), Allan S. Hoffman (Editor), Frederick J. Schoen (Editor), Jack E. Lemons, “Biomaterials Science: An Introduction to Materials in Medicine”, 2nd Edition, Academic Presswww.ethics.org , 2004
2. Duerig,T. W., Melton, K. N, Stockel, D. and Wayman, C.M., “Engineering aspects of Shapememory Alloys”, Butterworth – Heinemann, 1990.
3. Mohsen Shahinpoor and Hans-Jo¨rg Schneider “Intelligent Materials”, RSC Publishing, 2008
4. Mel Schwartz (Ed), Encyclopaedia of Smart Materials” Volume –I and II, John Wiley & Sons, Inc.2002
5. Rogers, C. A., Smart Materials, “Structures and Mathematical issues”, Technomic Publishing Co., U.S.A, 1989.

ML8003 PRINCIPLE AND APPLICATION OF EXTRACTIVE METALLURGY L T P C
3 0 0 3

OBJECTIVE:

- To provide a broad idea about various resources of metals, different extraction procedures and feasibility predictions for metallurgical reactions.

UNIT I PYROMETALLURGY 9

Sources of metals, unit processes of metal extraction- Pyrometallurgical Processes - Principles of drying, calcinations, agglomeration, roasting - roasting techniques, predominance area diagrams. Principles of smelting and converting. Ellingham diagrams. Carbothermic, Hydrothermic and Metallothermic reductions.

UNIT II HYDRO METALLURGY 9

Principles of hydrometallurgy, advantages, properties of good solvent. Preparation of ore for leaching, leaching methods recovery of metal from liquor, solvent extraction, ion exchange, pressure leaching, gaseous reduction of metals in aqueous solutions, material leaching, recycling of leach liquor.

UNIT III ELECTROMETALLURGYAND REFINING 9

Aqueous and fused salt electrolysis. Principles of electro refining and electro winning of metals, Purification of crude metals produced in bulk, distillation, liquation, solvent extraction, fire refining. electrolytic refining, and zone refining - examples.

UNIT IV EXTRACTION AND REFINING OF METAL ORES 9

Extraction and refining of metals from sulphide ores copper and nickel, Extraction and refining of metals from oxide ores Al. Mg. Zn, Extraction and refining of metals through halide route – Ti, Zr, U.

UNIT V EXTRACTION OF PRECIOUS METALS 9

Extraction of precious metals - gold and silver. Recovery of by-product metals and treatment of metallurgical wastes, material and energy balance.

TOTAL : 45 PERIODS

OUTCOMES:

- Explain different stages in Electro metallurgy
- Use the principles of pyro, Hydo and Electro for extraction
- Explain the steps of Metal ores.

TEXT BOOKS:

1. Ray. H.S., Sridhar R., Abraham. K P., “Extraction of Non Ferrous Metals”, Affiliated East – West Press Pvt. Ltd. New Delhi, 1990.
2. Terkel Rosenquist, “Principles of Extractive Metallurgy”, 2nd Edition, McGraw-Hill International Book Co. London, 1983.

REFERENCES:

1. Pehlke.R.D., “Unit Processes in Extractive Metallurgy”, American Elsevier Publishing Co., New York, USA, 1993.
2. Ray. H S., and Ghosh A., “Principles of Non-ferrous Extractive Metallurgy”, Prentice Hall of India, New Delhi, 1994.
3. Venkatachalam.S., “Hydrometallurgy”, Narosa Publishing House, New Delhi. 1998.

GE8075 INTELLECTUAL PROPERTY RIGHTS L T P C
3 0 0 3

OBJECTIVE:
- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION 9
Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 10
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS 10
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW 9
Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs 7
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL :45 PERIODS

OUTCOME:
- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS

1. S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002
2. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012

REFERENCES

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2012.
2. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.
3. Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education, 2011.

GE8073 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

OBJECTIVE:
To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 8
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES 9
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V APPLICATIONS 7
NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL : 45 PERIODS

OUTCOMES:
- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.
2. G Timp, “Nanotechnology”, AIP press/Springer, 1999.

ML8004 **AUTOMOTIVE MATERIALS** **L T P C**
3 0 0 3

OBJECTIVES:

- Knowledge on properties of engineering materials
- To select suitable materials for design
- Materials selection criteria for engine and transmission systems
- Different materials used for automotive structures.
- Different electronic materials for automotive applications

UNIT I ENGINEERING MATERIALS AND THEIR PROPERTIES 9

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

UNIT II BASIS OF MATERIAL SELECTION 9

Selection strategy, Attribute limits and Material indices, structural index Selection procedure: Design process - types of design, design requirements, Function, Material attributes, Shape and Manufacturing processes - Materials processing and design processes and their influence on design, Process attributes, Systematic process selection, Process selection diagrams, Process cost, Energy consumption for production, Material costs, Availability, Recyclability, Environmental consideration. Computer aided selection.

UNIT III MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS 9

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

UNIT IV MATERIALS FOR AUTOMOTIVE STRUCTURES 9

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

UNIT V ELECTRONIC MATERIALS FOR AUTOMOTIVE APPLICATIONS 9

Materials for electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, anti-collision, Anti-fog, Head lamps.

TOTAL: 45 PERIODS

OUTCOMES:

- Discuss different materials used for Automotive component manufacturing .
- Select proper material for Automobile applications

TEXT BOOKS:

1. Charles J A and Crane. F A. A., “Selection and Use of Engineering Materials”, 3rd Edition, Butterworths, London UK, 1996.
2. Gladius Lewis, “Selection of Engineering Materials”, Prentice Hall Inc. New Jersey USA, 1995.

REFERENCES:

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

ME8793	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the process planning concepts to make cost estimation for various products after process planning

UNIT I INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 select the process, equipment and tools for various industrial products.
CO2 prepare process planning activity chart.
CO3 explain the concept of cost estimation.
CO4 compute the job order cost for different type of shop floor.
CO5 calculate the machining time for various machining operations.

TEXT BOOKS:

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2. Sinha B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.

REFERENCES:

1. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.
2. K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Hanna Publishers 1990.
3. Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”, Pearson Education 2001.
4. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley, 1998.
5. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.

AT8091 MANUFACTURING OF AUTOMOTIVE COMPONENTS L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on basic principle and production methods of automotive components.

UNIT I CASTED ENGINE COMPONENTS 9

Material selection and Manufacturing methods for Piston, Piston rings, Cylinder block, wet and dry liners, Engine head, Oil pan, Carburetors. Thermal barrier coating of Engine head and valves.

UNIT II FORGED ENGINE COMPONENTS 8

Material selection and Manufacturing methods for Crank shaft, Connecting rod, Cam shaft, valve, Piston pin, Push rod, Rocker arm, tappets, spark plug.

UNIT III TRANSMISSION SYSTEM 10

Material selection and Manufacturing methods for Clutch – Clutch lining – Gear Box – Gear – Propeller Shaft – Differential – Axle Shaft – Bearing – fasteners – Wheel drum.

Methods of Gear manufacture – Gear hobbing and gear shaping machines - gear generation - gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching.

UNIT IV VEHICLE CHASSIS 8

Material selection and manufacturing methods for chassis, dead axle, leaf spring, coil spring and shock absorbers – wheel housing – steering system, Brake shoes, wheel rim, Tyres. Heat treatment procedures.

UNIT V RECENT DEVELOPMENTS 10

Surface treatment – Plastics – Plastics in Automobile vehicles – Processing of plastics - Emission control system – catalytic converter – Hydro forming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC liners –Selection of materials for Auto components. Use of Robots in Body weldment.

TOTAL : 45 PERIODS

OUTCOME

- Upon completion of this course the student can able to use the basic principle and production methods of automotive components

TEXT BOOK:

1. Heldt.P.M, "High speed combustion engines", Oxford publishing Co., New York, 1990.

REFERENCES:

1. Gupta K.M. "Automobile Engineering" Vol.I & II, Umesh Publishers, 2000.
2. Kirpal Singh, 'Automobile Engineering", Vol. I & II, Standard Publishers, New Delhi, 1997.
3. Newton and steels, the motor vehicle, ELBS, 1990
4. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Processes for Engineering Materials", Fourth Edition, Pearson Education publications – 2003

ME8072	RENEWABLE SOURCES OF ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- At the end of the course, the students are expected to identify the new methodologies / technologies for effective utilization of renewable energy sources.

UNIT I INTRODUCTION 9

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamil nadu, India and around the World – Potentials - Achievements / Applications – Economics of renewable energy systems.

UNIT II SOLAR ENERGY 9

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

UNIT III WIND ENERGY 9

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects

UNIT IV BIO - ENERGY 9

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Biomass Applications

UNIT V OTHER RENEWABLE ENERGY SOURCES 9

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy – Hydrogen and Storage - Fuel Cell Systems – Hybrid Systems.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 Discuss the importance and Economic of renewable Energy
CO2 Discuss the method of power generation from Solar Energy
CO3 Discuss the method of power generation from Wind Energy
CO4 Explain the method of power generation from Bio Energy
CO5 Explain the Tidal energy, Wave Energy, OTEC, Hydro energy, Geothermal Energy, Fuel Cells and Hybrid Systems.

TEXT BOOKS:

1. Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.

REFERENCES:

1. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2015.
2. David M. Mousdale – "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA 2017
3. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.
4. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
5. Johnson Gary, L. "Wind Energy Systems", Prentice Hall, New York, 1985

		L	T	P	C
MF8071	**ADDITIVE MANUFACTURING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To know the principle, methods, possibilities and limitations as well as environmental effects of Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing technologies.

UNIT I INTRODUCTION 9

Overview **–** Need - Development of Additive Manufacturing Technology -Principle **–** AM Process Chain-Classification **–** Rapid Prototyping- Rapid Tooling **–** Rapid Manufacturing **–** Applications-Benefits **–**Case studies.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

Design tools: Data processing - CAD model preparation **–** Part orientation and support structure generation **–** Model slicing **–**Tool path generation- Design for Additive Manufacturing: Concepts and objectives- AM unique capabilities **–** DFAM for part quality improvement- Customised design and fabrication for medical applications.

UNIT III PHOTOPOLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA-Photo curable materials **–** Process - Advantages and Applications. Powder Bed Fusion: SLS-Process description **–** powder fusion mechanism **–** Process Parameters **–** Typical Materials and Application. Electron Beam Melting.

UNIT IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

Extrusion Based System: FDM-Introduction **–** Basic Principle **–** Materials **–** Applications and Limitations **–** Bioextrusion. Sheet Lamination Process:LOM- Gluing or Adhesive bonding **–** Thermal bonding.

UNIT V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9

Droplet formation technologies **–** Continuous mode **–** Drop on Demand mode **–** Three Dimensional Printing **–** Advantages **–** Bioplotter - Beam Deposition Process:LENS- Process description **–** Material delivery **–** Process parameters **–** Materials **–** Benefits **–** Applications.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course, students will learn about a working principle and construction of Additive Manufacturing technologies, their potential to support design and manufacturing, modern development in additive manufacturing process and case studies relevant to mass customized manufacturing.

TEXT BOOKS:

1 Chua C.K., Leong K.F., and Lim C.S., **"**Rapid prototyping: Principles and applications**"**, Third edition, World Scientific Publishers, 2010.
2 Ian Gibson, David W.Rosen, Brent Stucker **"**Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing**"** Springer, 2010.

REFERENCES:

1 Andreas Gebhardt **"**Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing**"** Hanser Gardner Publication 2011.
2 Kamrani A.K. and Nasr E.A., **"**Rapid Prototyping: Theory and practice**"**, Springer, 2006.
3 Liou L.W. and Liou F.W., **"**Rapid Prototyping and Engineering applications: A tool box for prototype development**"**, CRC Press, 2007.
4 Tom Page **"**Design for Additive Manufacturing**"** LAP Lambert Academic Publishing, 2012.

GE8071 DISASTER MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

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) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, 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 V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXT BOOKS:

1. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
2. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

ML8005 INDUSTRIAL TRIBOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To introduce and expose students to the field and fundamentals in tribology and its applications.

UNIT I SURFACES AND FRICTION 9

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction– Adhesion-Ploughing- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion - Measurement of Friction.

UNIT II WEAR 9

Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.

UNIT III LUBRICANTS AND LUBRICATION TYPES 9

Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication- Hydrostatic Lubrication.

UNIT IV FILM LUBRICATION THEORY 9

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfield diagram.

UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS 9

Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes – Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to design friction, wear and Lubrication
- Ability to identify different types of sliding & rolling friction, Wear and related theories
- Ability to distinguish among the different Lubricant regime.
- Select materials for bearing.

TEXT BOOK:

1. A. Harnoy. “Bearing Design in Machinery “Marcel Dekker Inc, New York, 2003.

REFERENCES:

1. Cameron, “Basic Lubrication theory”, Longman, U.K.., 1981.
2. E. P. Bowden and Tabor.D., “Friction and Lubrication “, Heinemann Educational Books Ltd., 1974.
3. M. M. Khonsari & E. R. Booser, “Applied Tribology”, John Willey &Sons, New York, 2001.
4. M. J. Neale (Editor), “Tribology Handbook”, Newnes. Butterworth-Heinemann, U.K., 1995.

ML8006 CRYOGENIC TREATMENT OF MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- Students are to study and become familiar with this very specialized form of material treatment at low temperature.

UNIT I INTRODUCTION 9

Insight on Cryogenics-Basics, Properties of Cryogenic fluids, Liquefaction Cycles - Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve – Joule Thomson Effect.Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claude Cycle, Dual Cycle.

UNIT II CRYOCOOLERS 9

Cryocooler requirement- Satellite communication, Surveillance Imaging, Military applications, Impact of regenerative materials on cooler performance, Impact of material properties on cryocooler performance-Materials used, Thermal Properties, Electrical Properties, and Mechanical properties.

UNIT III CRYOGENIC PROCESSING 9

Historical Development of Cryogenic Treatment, Cryogenic for Ferrous Metals, Need for cryogenic treatment, Types of low temperature treatment and processors, Benefits of cryogenic treatment-Wear resistance, Stress Relieving, Hardness Precautions during cryogenic treatment.

UNIT IV MATERIALS ENGINEERING 9

Desirable qualities for materials used in cryogenic applications, History and applications of metallic / non-metallic materials, Understanding properties and fabrication processes of superconducting Nb3Sn wires, High temperature superconductors. Characterization of cryogenically processed materials.

UNIT V APPLICATIONS 9

Cryogenic processing of materials for Space applications, Superconductivity, Medical applications, Food Preservation-Individual Quick Freezing, Tool Industry, Automobiles etc.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to perform cryogenic treatment of materials
- Ability to select materials for cryogenic treatment
- Discuss the properties and application after cryogenic treatment of materials

TEXT BOOK:

1. Randall F. Barron, “Cryogenic Systems”, McGraw-Hill, 1985.

REFERENCES:

1. Jha, A. R., “Cryogenic Technology and Applications”, Butterworth-Heinemann, 2006
2. Klaus D. Timmerhaus and Richard P. Reed, “Cryogenic Engineering”, Springer, 2007.
3. Scott R. B., “Cryogenic Engineering”, Van Nostrand and Co., 1962.
4. William E. Bryson, “Cryogenics”, Hanser Gardner Publications,1999.

ML8007 FUELS, FURNACES AND REFRACTORIES L T P C
3 0 0 3

OBJECTIVES

- Knowledge on different source of fuel
- Knowledge about different types of furnaces
- Different types of refractories used for furnaces application
- Knowledge on issues in environment

UNIT I FUNDAMENTALS 9

Thermal Energy, conversion. Heat Transfer, conduction, radiation, convection. Thermoelectric effect. thermocouples, Peltier effect. Temperature measurement.

UNIT II FUELS 9

Thermal energy conversion. Fossil fuels, availability, deposits, calorific content. Nuclear Fuels, Solar and geothermal heating.

UNIT III FURNACES 9

Firing, electric resistance, Radiation, Induction. Temperature control-PID. Multi zone furnaces. Batch and tunnel furnaces.

UNIT IV REFRACTORIES 12

Bricks, Monolithic and castables. Manufacturing and properties of refractories. Refractories for iron and steel industry-Coke oven, blast furnace, LD converter, continuous casting, EAF and functional refractories. Refractories for Cement and non ferrous metallurgical industries.

UNIT V ADVANCED ISSUES 6

Energy and environment, environmental optimization, Recycling of thermal energy. Emissions control.

TOTAL:45 PERIODS

OUTCOMES

- Use of different fuels for energy generation system
- Use of refractories in furnance
- Ability to disscuss the issures in environmental.

TEXT BOOKS:

1. Gupta.O.P., "Elements of Fuels, Furnaces and Refractories",4th Edition, Khanna publishers,New Delhi, 2000.
2. Nandi D.N. "Handbook on Refractories" Tata Mcgraw – Hill publishing Co New Delhi 1991

REFERENCES

1. Chester, J.H. "Refractories, Production and Properties", Iron and Steel Institute, London, 1973.
2. Daniel Rhodes, Kilns: Design, "Construction and Operation", Chilton Book Co., Pennsylvania, 1974
3. Robert E.Fisher, "Advances in Refractory Technology", Ceramic Transaction, Vol.4, 1990, American Ceramic Society, Westerville,Ohio, USA.
4. Suryanarayana A.V.K, "Fuels, Furnaces, Refractories and Pyrometry", BS Publications, 2005.
5. Robert D.Reed, "Furnace Operation", Gulf Publishing Co., Paris, 1991.
6. Shaha A.K, "Combustion Engineering and Fuel Technology", Oxford & IBH Publishing Co., New Delhi, 1974.
7. Samir Sarkar, "Fuels and Combustion", 2nd Edition, Orient Longman, Bombay, 1990

ML8008 NUCLEAR REACTOR MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- Import knowledge about different nuclear materials
- Identify the materials for nuclear reactor and fuel
- Knowledge about nuclear waste and prevention techniques
- Know about irradiation effects in nuclear fuels.

UNIT I FUNDAMENTALS OF NUCLEAR ENGINEERING 9

Atomic structure, atomic number, mass number, isotopes, nuclear energy and nuclear forces, binding energy, nuclear stability, radioactivity, nuclear reactions, nuclear fissions, nuclear fusion

UNIT II NUCLEAR REACTORS 12

Types of reactors-ordinary water moderated reactors, heavy water cooled and moderated reactors-design, construction and control of nuclear reactors-moderators-coolants-reflectors and structural materials, nuclear power stations in India, comparison of nuclear power plants with thermal power plants

UNIT III FUELS 9

Ores and beneficiation – Uranium and thorium ores, availability in India, solvent extraction and ore beneficiation. fuels of different types – metallic, alloy and dispersion fuels for research reactors, ceramic (oxide, carbide and nitride) fuels for thermal power reactor and fast reactors.
Fabrication of oxide, mixed-oxide and mixed-carbide fuel for power reactors. Fabrication, characterization and property evaluation of advanced fuel type, processes encountered in fabrication, fuel property evaluation – thermal and physical properties

UNIT IV NUCLEAR WASTE AND RADIATION PROTECTION 6

Introduction-unit of nuclear radiation-Types of waste –disposal –ICRP recommendations-radiation hazards and prevention –radiation dose units

UNIT V IRRADIATION EFFECTS IN NUCLEAR FUELS 9

Irradiation Examination of Fuels, Irradiation behaviour of metallic uranium – irradiation growth, thermal cycling, swelling, adjusted uranium, blistering in uranium rods. Irradiation effects in ceramic oxide and mixed oxide fuels, definition and units of burnup, main causes of fuel element failure in power reactors and remedies to avoid failures. Behaviour of fuel under off normal and accident condition, criteria for fuel failure during LOCA: oxidation, deformation, stored energy

TOTAL: 45 PERIODS

OUTCOMES:

- Use of the Fuel in Nuclear reactor
- Ability to discuss the Nucleator radiation and the controlling methods.
- Ability to examine the fuels.

TEXT BOOKS:

1. Arora and Domkundwar, "Power plant Engineering", Dhanpati Rai &Co
2. Benedict M and Pigter T.A. "Nuclear Chemical Engineering" Mcgraw Hill 1981
3. Combined power plants by J.H.Horlocks by Pergamon press
4. L.C. Merrite, "Basic principles of Nuclear science and Reactors" Wiley Eastern 1977.
5. P.K.Nag, "Power Plant Engineering" Tata Mcgraw Hill, 2007

REFERENCES:

1. Frost, "Nuclear Fuel Elements: Design Fabrication and Performance", PERGAMON publications, 1982.
2. Gupta C K "Materials in Nuclear Applications" vol.1, CRC publications, 1989.
3. Kaufman A R, John Wiley, "Nuclear Reactor Fuel Elements, Metallurgy and Fabrication", 1962
4. Olander D R., "Fundamental Aspects of Nuclear Reactor Fuel Elements" NTIS publication, 1976.

GE8074 **HUMAN RIGHTS** **L T P C**
3 0 0 3

OBJECTIVE :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
2. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

ML8009 **FRACTURE MECHANICS AND FAILURE ANALYSIS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the basic concept of fracture mechanics and failure analysis
- Import knowledge on mechanics of fracture during static and dynamic loading
- Understanding the failure mechanism of creep rupture.
- Understand the mechanism of wear and corrosion and knowledge on prevention

UNIT I BASIC CONCEPTS IN FRACTURE MECHANICS **9**

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation, Brittle fracture: Griffiths theory, Ductile fracture, Probabilistic aspects of fracture mechanics - Microstructure

UNIT II MECHANICS OF FRACTURE- STATIC LOADING **9**

Elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – J integral and its relation to crack opening displacement. Strain energy release and stress intensity factor. Evaluation of fracture Toughness of different materials: size effect & control.

UNIT III FAILURE ANALYSIS OF FATIGUE FRACTURE 9

Fundamental sources of failures- Deficiency in design, Empirical Relation describing crack growth by fatigue – Life calculations for a given load amplitude – effects of changing the load spectrum – Effects of Environment. Micro-structural analysis of fatigue failures, some case studies in analysis of fatigue failures.

UNIT IV FAILURE ANALYSIS OF CREEP RUPTURE 9

Fracture at elevated temperature: Time dependent mechanical behavior, stress rupture, Micro Structural changes during creep, Mechanism of creep deformation and Creep deformation maps, Prediction of time to rupture, Creep-fatigue interaction. Some case studies in analysis of creep failures.

UNIT V FAILURE ANALYSIS OF CORROSION AND WEAR 9

Types of corrosion, Corrosion stress, corrosion cracking, Analysis of corrosion failure. Procedure for analysis of stress corrosion cracking. Effect of Environment. Analysis of corrosion characteristics of metals and alloys in different environment. Types of wear, Role of friction, Interaction of corrosion and wear. Analysis of wear failure.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to design structure to prevent failure from the internal defect that unit within the structure
- Ability to design structure to prevent fatigue and creep
- Ability to define different deformation and related theories
- Ability to analyse the corrosion and wear failure and system methods to prevent corrosion and wear.

TEXT BOOKS:

1. Hertz berg R W, “Deformation and fracture mechanics of Engineering Materials” Second Edition John Wiley sons inc, New York 1983.
2. Knott. J.F, “Fundamentals of Fracture Mechanics” Butterworth London, 1973.

REFERENCES:

1. Campbel J E, Underwood J H, and Gerberich W W., “Applications of Fracture Mechanics for the selection of Materials “, American Society for Metals, Metals Park Ohio, 1982.
2. Evalds H L and RJH Warnhil, ”Fracture Mechanics”, Edward Arnold Ltd, Baltimore,1984.
3. Fracture Mechanics Metals Handbook, ninth edition, vol. 8 437-491, American Society of Metals Metal Park ohio, 1985
4. Kare Hellan,“Introduction of Fracture Mechanics”, McGraw-Hill Book Company, 1985.
5. Prashant Kumar, “Elements of Fracture Mechanics”, Wheeler Publishing, 1999.

ML8010 FINITE ELEMENT ANALYSIS IN MATERIALS ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT I INTRODUCTION 9

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems – Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II ONE-DIMENSIONAL PROBLEMS 9

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors. Assembly of Matrices solution of problems from solid mechanics and heat transfer. Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts – Quadrilateral elements – Higher Order Elements.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION AND MISCELLANEOUS TOPICS 9

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

TOTAL: 45 PERIODS

OUTCOMES:

- Given a Structural engineering problem, ability to conduct structural analysis using FEA
- Use of mathematical techniques to solve Engineering problem using FEA.

TEXT BOOKS

1. J. N. Reddy, “Finite Element Method” Tata McGraw Hill, 2003.
2. Seshu. P. “Textbook of Finite Element Analysis” Prentice Hall of India, 2003.

REFERENCES

1. Chandrupatla and Belegundu, “Introduction to Finite Elements in Engineering” PHI / Pearson Education, 2003.
2. Cook R.D., Malkus. D.S. Plesha, ME., “Concepts and Applications of Finite Element Analysis”, John – Wiley Sons 2003.
3. Logan. D.L. “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002.
4. S.S. Rao, “The Finite Element Method in Engineering “Butter worth Heinemann, 2001.

ML8011 ALLOY CASTING PROCESSES L T P C
3 0 0 3

OBJECTIVE:

- The casting of metals is the focus of this course and covers not only steels, but also light metals like Magnesium and Aluminum. The casting of Zinc and Copper alloys is also treated in detail.

UNIT I MAGNESIUM ALLOYS 9

Introduction to different types of Magnesium alloys – Process for Manufacturing Magnesium alloys – Production considerations – Die casting consideration – die life productivity – applications of Magnesium alloy cast parts.

UNIT II ALUMINIUM ALLOYS 9

Introduction to different types of Aluminum alloys – Process for Manufacturing Aluminum alloys - Production considerations – die life – productivity – applications of Aluminum Cast Parts.

UNIT III ALLOY STEELS 9

Introduction to different types of Alloy steels – process for manufacturing alloy steels – production considerations – productivity – applications of alloy cast parts.

UNIT IV ZINC ALLOYS 9

Introduction to different types of Zinc alloys – process for manufacturing Zinc alloys – production considerations – Die casting considerations – die life – productivity – applications of Zinc alloys cast parts.

UNIT V COPPER ALLOYS 9

Introduction to different types of copper alloys. Process for manufacturing copper alloys production considerations. Die casting considerations – die life – productivity – applications of copper alloys cast parts.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to design casting process for alloys, such as Magnesium and Aluminum, Steel, Zinc, copper and its alloy.
- Ability to perform die life calculation, productivity

TEXT BOOKS:

1. Heine, R. W, Loper, C. R. and Rosenthal, “Principles of Metal Casting”, Tata McGraw Hill, New Delhi, 1995.
2. Jain, P. L., “Principles of Foundry Technology”, Tata McGraw Hill, 1994.

REFERENCES:

1. ASM Hand Book Vol. 5 Casting, ASM International, 1998.
2. Houldcorft, P. T.,“ Welding Process Technology”, Cambridge University Press, 1985.
3. Ramana Rao, T. V., “Metal Casting Principles and Practice”, 1st Edition, New Age International, 1996.

ML8012 METALLURGY OF TOOL MATERIALS AND SPECIAL STEELS L T P C
3 0 0 3

OBJECTIVE:

- Tooling materials require special considerations in production and application. Students will learn the metallurgical processes and applications in producing toolings.

UNIT I CLASSIFICATION AND MANUFACTURE OF TOOL STEELS 9

Classification - AISI system, production techniques – problems in melting - powder metallurgy route, Refining methods like VAR and ESR - forming of tool steels.

UNIT II HEAT TREATMENT OF TOOL STEELS 9

Spheroidising – selection of quenching and tempering parameters – precautions - Effect of retained austenite - Multiple tempering, sub-zero treatment and cryo treatment - surface treatments - defects in tool steels - Over heated and burnt structures - Decarburization.

UNIT III PROPERTIES AND TESTING OF TOOL STEELS 9

Mechanical propertiess of tool steels, strength, hardness and toughness – properties at elevated temperature – microstructure - distribution of carbides - coating thickness – micro hardness – adhesion and scratch resistance

UNIT IV ADVANCED TOOL MATERIALS 9

Sintered tungsten carbide tools - ISO classification – Uses of P, M and K grades – cermet – ceramics, mixed and reinforced grades – cubic boron nitride – poly crystalline diamond – manufacturing techniques – properties

UNIT V SPECIAL STEELS 9

Composition, microstructure, properties and applications of special steels- microalloyed steels- TRIP steels-HSLA steel etc

TOTAL : 45 PERIODS

OUTCOMES:

- Use of different steels for tool application
- Perform different Heat treatment on them to improve their properties
- Select the suitable

TEXT BOOK

1. Payson, Peter, "Metallurgy of Tool Steels", John Wiley and Sons, New York, 1962.

REFERENCES:

1. Joseph R. Davis," Tool Materials", ASM International, 1995
2. Robert Wilson, "Metallurgy and Heat Treatment of Tool Steels", McGraw-Hill, New York, 1975
3. Roberts, Haymaker and Johnson, "Tool Steels", 3rd Edition, ASM, 1962.

ML8013 LASER PROCESSING OF MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- To impart the knowledge about the principles of industrial lasers such as laser generation, mode selection, beam mechanisms, modifications and characteristics, types of lasers etc. Also to introduce the concepts of laser processing of materials which includes background of laser systems, process parameters, material considerations and specific applications.

UNIT I PRINCIPLES OF INDUSTRIAL LASERS 9

Principle of laser generation, optical resonators, laser modes- mode selection, line- broadening mechanisms, laser beam modifications and types of industrials lasers.

UNIT II THERMAL PROCESS- HEAT AND FLUID FLOW 9

Heat flow in the work piece: thick plate with point heat source, thin plate with line heat source, peak temperature and cooling rates Fluid flow in molten pool: continuity equation, navier-stokes equation and surface tension effects.

UNIT III LASER METALLURGY 9

Process microstructure- fusion zone, zone of partial melting, haz, discontinuities- porosity, cracking, lack of fusion, incomplete penetration and undercut.

UNIT IV LASER WELDING AND SURFACE MODIFICATIONS 9

Process mechanisms (Key hole and Plasmas) – operating characteristics – process variations – imperfections- industrial applications –recent developments Laser surface heat treatment, Laser surface melting- Glazing, Laser direct Metal deposition– Laser surface alloying, Laser surface cladding and Hard coatings, Laser physical vapour deposition and Laser shock peening.

UNIT V LASER MACHINING 9

Laser instrumentation for cutting and drilling – cut quality and process characteristics – methods of cutting – practical performance – process variations – industrial applications of Laser cutting and drilling.

TOTAL: 45 PERIODS

OUTCOMES:

- Discuss the Laser principles and use of it in processing of engineering materials.
- Use of it for Welding and surface modification of different Engineering materials.
- Perform Machining using Laser.

TEXT BOOKS:

1. Elijah kannatey-Asibu, Jr., “Principles of Laser Materials Processing“, John Wiley & Sons, 2009
2. Jacques Perrière, Eric Millon, Eric Fogarassy, “Recent advances in laser processing of Materials” Elsevier, 2006.

REFERENCES:

1. Duley W. W.,“ Laser Processing and Analysis of Materials”; Plenum Press, New York, 1983.
2. John C. Ion, “Laser Processing of Engineering Materials”, Elsevier Butter Worth-Heinemann, Burlington, 2005.
3. Narendra B. Dahotre, Sandip P. Harimkar, “Laser Fabrication and Machining of Materials” Springer,2008
4. Steen W. M.,“Laser Materials Processing”, 3rd Edition, Springer Verlag, U.K., 2003.
5. Ykalin, Ugloo A.,Kokona A.,“Laser and Electron Beam Material Processing”, Hand Book, MIR Publishers, 1987

ML8014 ENERGY STORAGE DEVICES AND FUEL CELLS L T P C
3 0 0 3

OBJECTIVES:

- Traditional use of fuels for storage Load management, Space conditioning, Transportation, Utility system, Variable energy sources, Role of different energy forms, Energy quality, Energy efficiency, Energy and power densities.
- Ability to converse about the working of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics. Able to analyze the cost effectiveness and eco-friendliness of Fuel Cells

UNIT I ENERGY DEMANDS AND ENERGY SOURCES 7

World energy consumption. Energy in developing countries. Firewood crises. Indian energy sources. Non-conventional renewable energy sources. Potential of renewable energy sources. Solar energy types. Wind energy. Wave, tidal and OTEC. Super-conductors in power system.

UNIT II NEED OF ENERGY STORAGE; DIFFERENT MODES OF ENERGY STORAG 9

Potential energy: Pumped hydro storage; KE and Compressed gas system: Flywheel storage, compressed air energy storage; Electrical and magnetic energy storage: Capacitors, electromagnets; Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical, electro-chemical, fossil fuels and synthetic fuels. Hydrogen for energy storage. Solar Ponds for energy storage

UNIT III ELECTROCHEMICAL ENERGY STORAGE SYSTEMS 10

Batteries: Primary, Secondary batteries; difference between primary and secondary batteries, chemistries of primary batteries such as Zinc-Carbon, Alkaline and secondary batteries such as Lead acid, Nickel Cadmium, Metal hydrides, lithium ion, lithium phosphate and high temperature batteries-sodium-sulphur. Advantages, disadvantages, limitations and application each above mentioned batteries

UNIT IV MAGNETIC AND ELECTRIC ENERGY STORAGE SYSTEMS 9

Superconducting Magnet Energy Storage(SMES) systems; Capacitor and Batteries: Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor (EDLC), principle of working, structure, performance and application, role of activated carbon and carbon nano-tube.

UNIT V FUEL CELL BASICS 10

Fuel cell definition, Difference between batteries and fuel cells, fuel cell history, components of fuel cells, principle of working of fuel cells, Fuel cell thermodynamics and its efficiency, Electrochemical kinetics, Butler-Volmer equation. Types of fuel cellsand its chemistries - AFC, PAFC,

PEMFC,MCFC and SOFC – merits and demerits. Fuel cells- global research development trends and application of PEMFC in automobile industry and application SOFC in stationery. Current issues in PEMFC, Direct methanol fuel cells (DMFC) - Electrochemical kinetics methanol oxidation, Hydrogen – production and storage methods for fuel cells.

TOTAL: 45 PERIODS

OUTCOMES:

- Explain and use different modes of energy storage
- Design and use of fuel cell for energy storage
- Perform calculation regarding energy efficiency

REFERENCES

1. J Larminie and A Dicks, “Fuel Cell Systems Explained", 2nd Edition, Wiley,2003
2. Johannes Jensen Bent Squrensen, “Fundamentals of Energy Storage”, John Wiley, NY , 1984.
3. IEE Energy Series’ “Electro-chemical Power Sources”.
4. O’Hayre, SW Cha, W Colella and FB Prinz, “Fuel Cell Fundamentals”, Wiley, 2005
5. P.D.Dunn, “Renewable Energies”. First Edition, Peter Peregrinus Ltd, London, United Kingdom , 1986
6. S Srinivasan, “Fuel Cells: From Fundamentals to Applications”, Springer 2006
7. Xianguo Li, “Principles of Fuel Cells”, Taylor and Francis, 2005

ML8015 SEMICONDUCTOR OPTOELECTRONIC MATERIALS AND DEVICES

L	T	P	C
3	0	0	3

OBJECTIVES:

- Impact Knowledge on semiconductor materials, mechanisms and processing techniques
- Develop knowledge on optoelectronic devices
- Explain the basics of semiconductor understanding of fundamentals of optoelectronics
- Explain the Quantum effects and relevant properties due to their effect
- Explain and use of different processing techniques
- Explain and design optoelectronic devices.

UNIT I BASICS OF SEMICONDUCTOR **9**

Energy bands and Charge carriers in Semiconductors: direct and indirect semiconductors (HUMO and LUMO), the E-k diagram, Density of states, Occupation probability, Fermi level and quasi Fermi levels, p-n junctions, Schottky junction and Ohmic contacts.

UNIT II FUNDAMENTS OF OPTOELECTRONICS **9**

Elements Of Light - Wave nature of light, Polarization, Interference, Diffraction, Light Source. Excess carriers in Semiconductors: optical absorption; photo, electro and cathode – luminescence. Relevence of III-V and IV-VI material-system in optoelectronic devices. Lasers - Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, Classes of Lasers.

UNIT III QUANTUM EFFECT **9**

Quantum confinement, Engineering classifications of nanostructures (1D, 2D, 3D confinement) - nano particles- quantum dots, nanowires-ultra-thin films ultilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, optical, Magnetic and Thermal properties. Semiconducting Hetrostructures.

UNIT IV ADVANCED PROCESSING TECHNIQUES **9**

Optoelectronic materials fabrication - Mechanical Milling, Colloidal routes, Selfassembly, CVD, MOCVD, Sputtering, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE and Lithography. Processing Environment - clean room technology: specifications and design, air and water purity, requirements for particular processes.

UNIT V MODERN OPTOELECTRONIC DEVICES 9

Optoelectronic Integrated Circuits: Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices. Quantum dot, quantum well lasers, LED, Photovoltaic, Photo-transisters, opto-electronic switches.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to relate impacts of semiconductor material properties into the optical properties of semiconductor devices.
- Ability to relate impacts of semiconductor material properties into the fabrication of semiconductor optoelectronic devices.

REFERENCES:

1. Jasprit Singh, “Opto Electronics – As Introduction to materials and devices”, McGraw-Hill International Edition, 1998.
2. Pallab Bhattacharya “Semiconductor Opto Electronic Devices”, Prentice Hall of India Pvt., Ltd., New Delhi, 2006.
3. Timp. G, "Nanotechnology", AIP press/Springer, 1999.

ML8016 MODELING AND SIMULATION IN MATERIALS ENGINEERING L T P C

3 0 0 3

OBJECTIVE:

- Modeling and simulation are important tools in understanding physical effects in many technological applications. This course should enable students to use standard packages for modeling and simulation applicable to Materials Science and Engineering.

UNIT I INTRODUCTION TO MODELING AND MATHEMATICAL CONCEPTS 9

Mathematical modeling, physical simulation, advantages and limitations - Review of differential equations, numerical methods, introduction to FEM, FDM- Governing differential equations of elastic, plastic deformation, fluid flow and heat transfer – basic steps in FEM

UNIT II CONSTITUTIVE EQUATIONS IN FUNCTIONAL MATERIALS 9

Thermoelectric and electromagnetic properties of solids, Constitutive equations in electromagnetism, Maxwell’s equation – microscopic and macroscopic approach, Constitutive equations for thermoelectric materials, Thermo-elastic conductors, Magnetizable conductors and Super conductivity

UNIT III CONSTITUTIVE EQUATIONS IN STRUCTURAL MATERIALS 9

Basic concepts from continuum mechanics, Stress tensor, Strain tensor, Strain rate tensor, Equation in conductivity and motion. Constitutive equations for ideal elastic material: Gauchy’s method and Grees’s Method. Constitutive equations for plasticity: Ideal plastic material and work hardenable plastic material.

UNIT IV SOFTWARE PACKAGES 9

Introduction to standard software packages – General purpose FEA packages such as ANSYS, ABAQUS, NASTRAN etc. – Special purpose packages such as DEFORM, OPTIFORM, ProCAST, etc. - Applications of FEA in simulation of sheet metal and bulk forming, solidification of casting and weldment, Concepts of coupled analysis

UNIT V COMPUTER APPLICATIONS IN PHYSICAL METALLURGY 9

Use of computers for the construction of phase diagrams, Features of CALPHAD – Expert system for alloy design and selection of materials – computer applications in crystallography.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to

- Apply numerical techniques to a variety of materials process including solidification, heat treatment, grain from the recovery stabilization
- Able to evaluate the capabilities and limitation of commercial software.

TEXT BOOKS:

1. AMIE, "Modeling of casting and welding process", Volume I & II, the Metallurgical society of AMIE, 1981&1983.
2. Reddy J. N., "An Introduction to Finite Element Method", McGraw-Hill International Student Edition, 1985.

REFERENCES:

1. Cerjak H., "Mathematical Modeling of Weld Phenomenon-2", The Institute of Materials,1995.
2. O. C. Zienkiewicz and R. L. Taylor, "The Finite Element Methods, Vol.1. The basic formulation and linear problems", 5th Edition, Vol. 1, Butterworth Heineman, 2000.
3. Piwonoka T.S., Vollen V., Katgerman l., "Modeling of Casting, Welding, and Advanced Solidification Process", 4th edition, TMS-AIME, USA, 1993
4. Stocks G.M., Turchi P.E.A., "Alloy Modeling and Design", the Metals Society, AMIE, USA,1994.
5. Trivedi R., Sekhar J.A., Majumudar J., "Principles of Solidification and Material Processing", Volume I&II, Oxford and IBH, New Delhi, 1989.

IE8791 DESIGN OF EXPERIMENTS L T P C

3 0 0 3

AIM:

This course aims to introduce students how to statistically plan, design and execute industrial experiments for process understanding and improvement in both manufacturing and service environments

OBJECTIVES:

- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE)
- To demonstrate knowledge and understanding of Taguchi's approach
- To develop skills to design and conduct experiments using DOE and Taguchi's approach
- To develop competency for analysing the data to determine the optimal process parameters that optimize the process.

UNIT I FUNDAMENTALS OF EXPERIMENTAL DESIGNS 9

Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.

UNIT II SINGLE FACTOR EXPERIMENTS 9

Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman-Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications.

UNIT III FACTORIAL DESIGNS 9

Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2^K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS 9

Blocking and Confounding in 2^K Designs- blocking in replicated design- 2^K Factorial Design in two blocks- Complete and partial confounding- Confounding 2^K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2^K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2^K Design- introduction to response surface methods, central composite design.

UNIT V TAGUCHI METHODS 9

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design- case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- To understand the fundamental principles of Classical Design of Experiments
- To apply DOE for process understanding and optimisation
- To describe the Taguchi's approach to experimental design for process performance robustness
- To apply Taguchi based approach to evaluate quality

TEXT BOOK:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2012.

REFERENCES:

1. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., "Statistics for Experimenters: Design, Innovation, and Discovery", 2nd Edition, Wiley, 2005.
2. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.
3. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.

GE8076 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
2. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ‘Value Education’, Vethathiri publications, Erode, 2011.

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org