ANNA UNIVERSITY CHENNAI
CHENNAI - 600 025

UNIVERSITY DEPARTMENTS

REGULATIONS 2012
CURRICULLA AND SYLLABI FOR
I TO VIII SEMESTERS

B.E. MATERIALS SCIENCE AND ENGINEERING (FULL TIME)

Attested

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Centre For Academic Courses
Anna University, Chennai-600 025.

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ANNA UNIVERSITY, CHENNAI-600 025

UNIVERSITY DEPARTMENTS

R – 2012

B.E. MATERIALS SCIENCE AND ENGINEERING

I – VIII SEMESTERS CURRICULA AND SYLLABI

I SEMESTER

SL. NO	CODE NO	COURSE TITLE	L	T	P	C
1	HS8151	Technical English-I	3	1	0	4
2	MA8151	Mathematics -I	3	1	0	4
3	PH8151	Engineering Physics	3	0	0	3
4	CY8151	Engineering Chemistry	3	0	0	3
5	GE8151	Computing Techniques	3	0	0	3
6	GE8152	Engineering Graphics	2	0	3	4
PRACTICALS						
7	PH8161	Physics Laboratory	0	0	2	1
8	CY8161	Chemistry Laboratory	0	0	2	1
9	GE8161	Computer Practices Laboratory	0	0	3	2
10	GE8162	Engineering Practices Laboratory	0	0	3	2
		TOTAL	**17**	**2**	**13**	**27**

II SEMESTER

SL. NO	CODE NO	COURSE TITLE	L	T	P	C
1	HS8251	Technical English II	3	1	0	4
2	MA8251	Mathematics - II	3	1	0	4
3	CY8201	Chemical Reactions Dynamics	3	0	0	3

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4	GE8251	Engineering Mechanics	3	1	0	4
5	ME8251	Design concepts in Engineering	3	0	0	3
6	ML8201	Structure and Properties of Materials	3	0	0	3
PRACTICALS						
7	CY8212	Chemical Element Analysis Laboratory	0	0	3	2
8	ML8211	Microstructural Analysis Laboratory	0	0	3	2
		TOTAL	18	3	6	**25**

III SEMESTER

SL NO	**CODE NO**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	MA8352	Applied Statistics	3	1	0	4
2	CY8302	Polymer Science and Engineering	3	0	0	3
3	CE8353	Strength of Materials	3	0	0	3
4	ML8301	Casting and Machining Processes	3	0	0	3
5	ML8302	Solid State Physics	3	1	0	4
6	ML8303	Thermodynamics of Materials	3	0	0	3
PRACTICALS						
7	CE8362	Strength of Materials Laboratory	0	0	3	2
8	ML8311	Foundry Practices Laboratory	0	0	3	2
9	ML8312	Manufacturing Technology Laboratory	0	0	3	2
		TOTAL	**18**	**2**	**9**	**26**

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IV SEMESTER

SL. NO	CODE NO	COURSE TITLE	L	T	P	C
1	GE8351	Environmental Science and Engineering	3	0	0	3
2	ME8452	Mechanics of Machines	3	0	0	3
3	ML8401	Analytical Instrumentation Techniques	3	0	0	3
4	ML8402	Iron and Steel Making	3	0	0	3
5	ML8403	Mechanical Metallurgy	3	0	0	3
6	ML8404	Powder Metallurgy	3	0	0	3
PRACTICALS						
7	ML8411	Analytical Instrumentation Laboratory	0	0	3	2
8	ML8412	Powder Metallurgy Laboratory	0	0	3	2
		TOTAL	18	0	6	22

V SEMESTER

SL. NO	CODE NO	COURSE TITLE	L	T	P	C
1	ME8553	Machine Design	3	1	0	4
2	ML8501	Characterisation of Materials	3	0	0	3
3	ML8502	Heat Treatment of Metals and Alloys	3	0	0	3
4	ML8503	Theory and Applications of Metal Forming	3	0	0	3
5		Elective I	3	0	0	3
6		Elective II	3	0	0	3
PRACTICALS						
7	ML8511	Heat Treatment Laboratory	0	0	3	2
8	ML8512	Metal Forming Laboratory	0	0	3	2
		TOTAL	**18**	**1**	**6**	**22**

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VI SEMESTER

SL. NO	CODE NO	COURSE TITLE	L	T	P	C
1	ME8652	Industrial Management	3	0	0	3
2	ML8601	Ceramic Science and Technology	3	0	0	3
3	ML8602	Composite Materials	3	0	0	3
4	ML8603	Nondestructive Evaluation of Materials	3	0	0	3
5		Elective – III	3	0	0	3
6		Elective – IV	3	0	0	3
PRACTICALS						
7	HS8561	Employability Skills	0	0	2	1
8	ML8611	Composite Materials Laboratory	0	0	3	2
9	ML8612	Creative and Innovative Project	0	0	3	2
10	ML8613	Materials Characterisation Laboratory	0	0	3	2
		TOTAL	**18**	**0**	**11**	**25**

VII SEMESTER

SL. NO	CODE NO	COURSE TITLE	L	T	P	C
1	ML8701	Corrosion and its protection methods	3	0	0	3
2	ML8702	Metal Joining Processes and Metallurgy	3	0	0	3
3	ML8703	Nonferrous Metallurgy	3	0	0	3
4		Elective – V	3	0	0	3
5		Elective – VI	3	0	0	3
6		Elective – VII	3	0	0	3
PRACTICALS						
7	ML8711	Industrial/ Field Training *	0	0	3	2
8	ML8712	Surface Engineering Laboratory	0	0	3	2
		TOTAL	**18**	**0**	**6**	**22**

***FOUR WEEKS INDUSTRIAL TRAINING DURING SIxTH SEMESTER HOLIDAYS**

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VIII SEMESTER

SL. NO	CODE NO	COURSE TITLE	L	T	P	C
1		Elective – VIII	3	0	0	3
2		Elective –IX	3	0	0	3
PRACTICALS						
3	ML8811	Project Work	0	0	12	6
		TOTAL	**6**	**0**	**12**	**12**

TOTAL -182 CREDITS

ELECTIVES

NO.	CODE. NO	COURSE TITLE	L	T	P	C
1	ML8001	Bio and Smart Materials	3	0	0	3
2	ML8002	Casting Processes	3	0	0	3
3	ML8003	Computer Applications in Materials Science	3	0	0	3
4	ML8004	Creep and Fatigue Behaviour of Materials	3	0	0	3
5	ML8005	Cryogenic Treatment of Materials	3	0	0	3
6	ML8006	Electron Microscopy and Diffraction Analysis of Materials	3	0	0	3
7	ML8007	Energy Storing Devices and Fuel Cells	3	0	0	3
8	ML8008	Fracture Mechanics and Failure Analysis	3	0	0	3
9	ML8009	Fuels, Furnaces and Refractories	3	0	0	3
10	ML8010	Industrial Tribology	3	0	0	3
11	ML8011	Introduction to Transport Phenomena	3	0	0	3
12	ML8012	Laser Processing of Materials	3	0	0	3
13	ML8013	Making and Metallurgy of Stainless Steels	3	0	0	3
14	ML8014	Metallurgy of Tool Materials	3	0	0	3
15	ML8015	Micro Machining and Fabrication	3	0	0	3
16	ML8016	Modeling and Simulation in Materials Engineering	3	0	0	3
17	ML8017	Nanostructured Materials	3	0	0	3
18	ML8018	Nuclear Materials	3	0	0	3
19	ML8019	Phase Transformations	3	0	0	3
20	ML8020	Principles of Metal Cutting	3	0	0	3
21	ML8021	Thin Film Technology	3	0	0	3

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22	ML8071	Automotive Materials	3	0	0	3
23	GE8751	Engineering Ethics and Human values	3	0	0	3
24	MG8654	Total Quality Management	3	0	0	3
25	IE8755	Design of Experiments	3	0	0	3
26	ME8010	Applied Thermal Engineering	3	0	0	3
27	ME8071	Automobile Engineering	3	0	0	3
28	ME8076	Entrepreneurship Development	3	0	0	3
29	ME8077	Marketing Management	3	0	0	3
30	ME8079	Non-traditional Machining Processes	3	0	0	3
31	ME8081	Reliability Concepts in Engineering	3	0	0	3
32	ME8752	Finite Element Analysis	3	0	0	3
33	GE8072	Disaster Management	3	0	0	3
34	GE8073	Human Rights	3	0	0	3

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HS8151 **TECHNICAL ENGLISH I** **L T P C**

(For all branches of B.E / B.Tech programmes) **3 1 0 4**

OBJECTIVES

- To enable all students of engineering and technology develop their basic communication skills in English.
- To give special emphasis to the development of speaking skills amongst the students of engineering and technology.
- To ensure that students use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading for pleasure.

UNIT I

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); **Speaking** - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; **Reading** - Skimming a reading passage – Scanning for specific information - Note-making; **writing** - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); **Grammar** - Prepositions - Reference words - Wh-questions - Tenses (Simple); **Vocabulary** - Word formation - Word expansion (root words / etymology); **E-materials** - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II

Listening - Listening and responding to video lectures / talks; **Speaking** - Describing a simple process (filling a form, etc.) - Asking & answering questions - Telephone skills – Telephone etiquette; **Reading** – Critical reading - Finding key information in a given text - Sifting facts from opinions; **writing** - Biographical writing (place, people) - Lab descriptions (general/specific description of laboratory experiments) - Definitions - Recommendations; **Grammar** - Use of imperatives - Subject-verb agreement; **Vocabulary** - Compound words - Word Association; **E-materials** - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - **Speaking** in formal situations (teachers, officials, foreigners); Reading - **Reading** and interpreting visual material; **writing** - Jumbled sentences - Coherence and

cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause & effect / compare & contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; **Grammar** - Tenses (Past) - Use of sequence words - Adjectives; **Vocabulary** - Different forms and uses of words, Cause and effect words; **E-material**s - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV

Listening - Watching videos / documentaries and responding to questions based on them; **Speaking** - Responding to questions - Different forms of interviews - Speaking at different types of interviews; **Reading** - Making inference from the reading passage - Predicting the content of a reading passage; **writing** - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; **Grammar** - Adverbs – Tenses – future time reference; **Vocabulary** - Single word substitutes - Use of abbreviations & acronyms; **E-materials** - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V

Listening - Listening to different accents, Listening to Speeches / Presentations, Listening to broadcast & telecast from Radio & TV; **Speaking** - Giving impromptu talks, Making presentations on given topics; **Reading** - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email **writing** - Creative writing, Poster making; **Grammar** - Direct and indirect speech; **Vocabulary** - Lexical items (fixed / semi fixed expressions); **E-materials** - Interactive exercises for Grammar & Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents, - Interpreting posters

TOTAL: 60 PERIODS

OUTCOMES:

Learners should be able to

- Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- Read different genres of texts adopting various reading strategies.
- Listen/view and comprehend different spoken discourses/excerpts in different accents

TEXT BOOkS

1. Mindscapes: English for Technologies and Engineers, Orient Black Swan, 2012.
2. S.P. Dhanavel, English and Communication Skills for students of Science and Engineering Oriented Black Swan, Chennai 2011.

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REFERENCE BOOkS:

1. Pickett, Nell Ann, Ann A.Laster and Katherine E.Staples. **Technical English: writing, Reading and Speaking**. New York: Longman, 2001.
2. Bailey, Stephen. **Academic writing: A practical guide for students**. New York: Rutledge, 2011.
3. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. Reading: Garnet Publishing Limited, 2008.
4. Thorn, Michael and Alan Badrick. **An Introduction to Technical English**. Harlow: Prentice Hall Europe, 1993.
5. Rizvi, M.Ashraf. **Effective Technical Communication**. New Delhi: Tata McGraw-Hill PublishingCompany, 2007.

ExTENSIVE READERS:

1. Murthy, Sudha. **wise & Otherwise**. New Delhi: Penguin Books India, 2006.
2. Gates, Bill and Collins Hemingway. B**usiness @ the Speed of Thought: Succeeding in the Digital Economy**. New York: Warner Business Books, 2000.

wEBSITE RESOURCES

- www.uefap.com
- www.eslcafe.com
- www.listen-to-english.com
- www.owl.english.purdue.edu
- www.chompchomp.com

MA8151 **MATHEMATICS – I** **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes in I Semester) **3 1 0 4**

OBJECTIVES:

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.

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- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES **9+3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues 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 INFINITE SERIES **9+3**

Sequences – Convergence of series – General properties – Series of positive terms – Tests of convergence (Comparison test, Integral test, Comparison of ratios and D'Alembert's ratio test) – Alternating series – Series of positive and negative terms – Absolute and conditional convergence – Power Series – Convergence of exponential, logarithmic and Binomial Series.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+3**

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

UNIT IV IMPROPER INTEGRALS **9+3**

Improper integrals of the first and second kind and their convergence – Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions – Properties – Evaluation of integrals using Beta and Gamma functions – Error functions.

UNIT V MULTIPLE INTEGRALS **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals – Area of a curved surface.

TOTAL : 60 PERIODS

OUTCOMES:

- This course equips students to have basic knowledge and understanding in one field of materials, integral and differential calculus

TExT BOOkS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition, 2011.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.

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REFERENCES:

1. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
2. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8151 ENGINEERING PHYSICS L T P C

(Common to ALL Branches of B.E./B.Tech. Programmes) 3 0 0 3

OBJECTIVE:

To introduce the basic physics concepts relevant to different branches of Engineering and Technology

UNIT I PROPERTIES OF MATTER 9

Elasticity - Poisson's ratio and relationship between modules (qualitative) - Stress-strain diagram - factors affecting elasticity - bending of beams - cantilever - bending moment - theory and experiment of Young's modulus determination - Uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - rate of growth and decay of sound intensity - derivation of Sabine's formula - absorption coefficient and its determination - factors affecting acoustics of buildings : focussing, interference, echo, Echelon effect, resonance - noise and their remedies. Ultrasonics - production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating - industrial applications - NDT - Ultrasonic method: scan modes and practice.

UNIT III THERMAL PHYSICS 9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity - conductions in solids - Forbe's and Lees' disc methods - Rectilinear flow of heat through a rod - flow of heat through a compound materials - radical flow of heat through a spherical shell - thermal insulation of buildings – Laws of blackbody radiation: Kirchoffs law, Stephens

law, Wiens law, Raleigh-Jean law and Planks law (derivation). Laws of thermodynamics - Otto and diesel engines and their efficiency - entropy - entropy of Carnot's cycle - reverse Carnot's cycle - refrigerator.

UNIT IV APPLIED OPTICS **9**

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its application - Lasers - Einstein's coefficients - CO2, Nd:YAG and semiconductor lasers - homo junction and hetro junction - construction and working - applications - Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

UNIT V SOLID STATE PHYSICS **9**

Nature of bonding - growth of single crystals (qualitative) - crystal systems - crystal planes and directions - expressions for interplanar distance - coordination number and packing factor for simple structures: SC, BCC, FCC and HCP - structure and significance of NaCl, ZnS, diamond and graphite - crystal imperfections: point defects, dislocations and stacking faults - unit cell, Bravais space lattices - miller indices.

TOTAL : 45 PERIODS

OUTCOMES:

- The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

TEXT BOOkS:

1. Gaur R.K., and Gupta, S.L., Engineering Physics, Dhanpat Raj Publications,2003.
2. Palanisamy, P.K., Engineering Physics, Scitech Publications (P) Ltd, 2006.
3. Arumugam, M., Engineering Physics, Anuradha Publications, 2000.

REFERENCES:

1. Sankar, B.N., Pillai.S.O., Engineering Physics, New Age International (P) Ltd., 2007.
2. Rajendran.V Engineering Physics, Tata McGraw-Hill, 2009.

CY8151 **ENGINEERING CHEMISTRY** **L T P C**

(Common to all branches of Engineering and Technology) **3 0 0 3**

OBJECTIVES:

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I CHEMICAL THERMODYNAMICS 9

Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation – variation of chemical potential with temperature and pressure.

UNIT II POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and Synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerisation. Types and mechanism of polymerisation: Addition (Free Radical, cationic, anionic and living); condensation and copolymerisation. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerisation: Bulk, emulsion, solution and suspension.

UNIT III kINETICS AND CATALYSIS 9

Introduction – reaction velocity, factors affecting reaction velocity, rate constant, order of reaction, molecularity, pseudo molecular reactions, zero, first, second and third order reactions, reactions of fractional orders, determination of order of reactions. Catalysis: Auto catalysis - Enzyme Catalysis: Michaelis - Menton equation; factors affecting enzyme catalysis. Heterogeneous Catalysis: Types of adsorption isotherms: Langmuir–Hinselwood and Rideal–Eley Mechanism.

UNIT IV PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Photoprocesses - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitisation. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram) and applications.

UNIT V NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: Nanocluster, nanorod, nanotube and nanowire. Synthesis:

Precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and Applications. Risk discussion and Future perspectives.

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXTBOOKS:

1. P. Kannan and A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009.
2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India, 2011

REFERENCES: BOOkS:

1. P.W. Atkins and de Paula Julio, “Physical Chemistry”, Oxford University Press, 8th Ed., (Indian Student Edition) (2009).
2. K. K. Rohatgi-Mukherjee, “Fundamental of Photochemistry” New Age International (P) Ltd., New Delhi, 1986.
3. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.
4. V.R.Gowariker, N.V.Viswanathan and Jayadev Sreedhar, “Polymer Science”, New Age International P (Ltd.,), Chennai, 2006

GE8151 COMPUTING TECHNIQUES L T P C 3 0 0 3

OBJECTIVES:

The students should be made to:

- Learn the organization of a digital computer.
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I INTRODUCTION 8

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

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UNIT II C PROGRAMMING BASICS **10**

Problem formulation – Problem Solving - Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS **9**

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS **9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS **9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Design C Programs for problems.
- Write and execute C programs for simple applications.

TEXTBOOKS:

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. " Let Us C", BPB Publications, 2011.

REFERENCES:

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, " Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

GE8152 **ENGINEERING GRAPHICS** **L T P C**
2 0 3 4

OBJECTIVES :

To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and 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 FREE HAND SkETCHING **14**

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, Scales: Construction of Diagonal and Vernier scales.

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES **14**

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 trapezoidal 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 **14**

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 and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **14**

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. Development of lateral surfaces of solids with cut-outs and holes

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UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 15

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 and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3

Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- perform free hand sketching of basic geometrical constructions and multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.
- demonstrate computer aided drafting.

TExT BOOkS:

1. N.D.Bhatt and V.M.Panchal, “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. K.R.Gopalakrishna., “Engineering Drawing” (Vol I&II combined) Subhas Stores, Bangalore, 2007
2. 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
3. M.B.Shah and B.C.Rana, “Engineering Drawing”, Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International (P) Limited ,2008.
5. K. V.Natrajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi,2008.

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:

- There will be five questions, each of either or type covering all units of the syllabus.
- All questions will carry equal marks of 20 each making a total of 100.
- 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.
- The examination will be conducted in appropriate sessions on the same day

PH 8161	PHYSICS LABORATORY	L T P C
	(Common to all branches of B.E. / B.Tech. Programmes)	**0 0 2 1**

OBJECTIVES:

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

1.	Torsional pendulum	Determination of rigidity modulus of wire and moment of inertia of disc
2.	Non–uniform bending	Determination of young's modulus
3.	Lee's disc	Determination of thermal conductivity of a bad conductor
4.	Potentiometer	Determination of thermo e.m.f. of thermocouple
5.	Air wedge	Determination of thickness of a thin sheet of paper
6.	i. Optical fibre	Determination of Numerical Aperture and acceptance angle
	ii. Compact disc	Determination of width of the groove using laser
7.	Acoustic grating	Determination of velocity of ultrasonic waves in liquids
8.	Post office box	Determination of Band gap of a semiconductor
9.	Spectrometer	Determination of wavelength using grating
10.	Viscosity of liquids	Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

TOTAL : 30 PERIODS

OUTCOMES:

- The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

CY8161	CHEMISTRY LABORATORY	L T P C
	(Common to all branches of engineering and technology)	**0 0 2 1**

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 vacometry.

1. Estimation of HCl using Na2CO3 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 poly vinyl 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.

TOTAL: 30 PERIODS

OUTCOMES:

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

REFERENCE BOOkS

1. A text of quantitative inorganic analysis, A. L. Vogel , ELBS London. 1995.
2. Experiments in physical chemistry, D.P. Shoemarker and C.W. Gardad, McGraw Hill, London, 2001
3. American Public Health Association.

GE8161 COMPUTER PRACTICES LABORATORY L T P C

0 0 3 2

OBJECTIVES:

The student should be made to:

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

GE8162 ENGINEERING PRACTICES LABORATORY L T P C

(Common to all Branches of B.E. / B.Tech. Programmes) 0 0 3 2

OBJECTIVE:

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 & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICE 12

Plumbing

Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.

Laying pipe connection to the suction side of a pump – inlet.

Laying pipe connection to the delivery side of a pump – out let.

Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.

wood work

Sawing, planning and making common joints: T-Joint, Mortise and Tennon joint, Dovetail joint.

Study

Study of joints in door panels, wooden furniture

Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICE **9**

- Basic household wiring using switches, fuse, indicator – lamp etc.,
- Preparation of wiring diagrams
- Stair case light wiring
- Tube – light wiring
- Study of iron-box, fan with regulator, emergency lamp

GROUP – B (MECHANICAL AND ELECTRONICS) **15**

3. MECHANICAL ENGINEERING PRACTICE

welding

- Arc welding of butt joints, lap joints, tee joints
- Gas welding Practice.
- Basic Machining
- Simple turning, drilling and tapping operations.
- Machine assembly Practice.
- Study and assembling the following:
- Centrifugal pump, mixies and air conditioners.
- Demonstration on
  Smithy operations like the production of hexagonal bolt.
  Foundry operation like mould preparation for grooved pulley.

4. ELECTRONIC ENGINEERING PRACTICE **9**

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and testing.
- Study of Telephone, FM radio, low-voltage power supplies.

TOTAL: 45 PERIODS

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OUTCOMES:

- Ability to fabricate carpentry components and pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to fabricate electrical and electronics circuits

HS8251	TECHNICAL ENGLISH II	L T P C
	(For all branches of B.E / B.Tech programmes)	**3 1 0 4**

OBJECTIVES

- To make the students acquire listening and speaking skills meant for both formal and informal contexts
- To help them develop their reading skills by exposing them to different types of reading strategies
- To equip them with writing skills needed for academic as well as workplace situations
- To make them acquire language skills at their own pace by using e-materials and language lab component

UNIT I

Listening - Listening to informal conversations and participating; **Speaking** - Opening a conversation (greetings, comments on something, weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); **Reading** - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; **writing** - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; **Grammar** - Regular & irregular verbs - Active and passive voice; **Vocabulary** - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); **E-materials** - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II

Listening - Listening to situation based dialogues; **Speaking** - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); **Reading** - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; **writing** - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his success, thanking one's friend / relatives); **Grammar** - modal verbs, Purpose expressions; **Vocabulary** - Phrasal verbs and their meanings, Using phrasal verbs in sentences; **E-materials** - Interactive exercise on Grammar and vocabulary, Extensive reading activity (reading stories / novels from links), Posting reviews in blogs - Language Lab

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- Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III

Listening - Listening to the conversation - Understanding the structure of conversations; **Speaking** - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret etc.); **Reading** - Speed reading – reading passages with the time limit - Skimming; **writing** - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading the articles from the journals - Format for the journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; **Grammar** - Conditional clauses - Cause and effect expressions; **Vocabulary** - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); **E-materials** - Interactive exercise on Grammar & vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU materials – Attending a meeting and writing minutes.

UNIT IV

Listening - Listening to a telephone conversation, Viewing a model interview (face-to-face, telephonic and video conferencing) and observing the practices; **Speaking** - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping the interview skills; **Reading** - Reading the job advertisements and the profile of the company concerned – scanning; **writing** - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; **Grammar** - Numerical expressions - Connectives (discourse markers); **Vocabulary** - Idioms and their meanings – using idioms in sentences; **E-materials** - Interactive exercises on Grammar & Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; **Speaking** - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; **Reading** - Note making skills – making notes from books, or any form of written materials - Intensive reading **writing** - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); **Grammar** - Use of clauses; **Vocabulary** – Collocation; **E-materials** - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises - Pictures for discussion; Language Lab- Different models of group discussion

TOTAL: 60 PERIODS

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OUTCOMES:

Learners should be able to

- Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- Write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- Read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- Listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

TEXT BOOkS:

1. Mindscapes: English for Technologies and Engineers, Orient Black Swan, 2012.
2. S.P. Dhanavel, English and Communication Skills for students of Science and Engineering Oriented Black Swan, Chennai 2011.

REFERENCE BOOkS:

1. Laws, Anne. **Presentations**. Hyderabad: Orient BlackSwan, 2000.
2. Lewis, Hedwig. **Body Language: A Guide for Professional**s. New Delhi: Sage Publications, 1998.
3. Naterop, Jean B. and Rod Revell. **Telephoning in English**. Cambridge: Cambridge University Press, 1987.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Ur, Penny. **Teaching Listening Comprehension**. Cambridge: Cambridge University Press, 1984.

EXTENSIVE READERS

1. Abdul Kalam, A P J. **Ignited Minds: Unleashing the Power within India**. New Delhi: Penguin Books India, 2002.
2. Parameswaran, Uma. **C.V.Raman: A Biography.** New Delhi: Penguin Books India, 2011.

WEB RESOURCES

- www.esl-lab.com
- www.englishgrammar.org
- www.englishclub.com
- www.mindtools.com
- www.esl.about.com

MA8251 **MATHEMATICS II** **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes in ii semester) **3 1 0 4**

OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I DIFFERENTIAL EQUATIONS **9+3**

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

UNIT II VECTOR CALCULUS **9+3**

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

UNIT III ANALYTIC FUNCTION **9+3**

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - $w = z + c$, az, $1/z$, z^2 - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION **9+3**

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 with no pole on real axis.

UNIT V LAPLACE TRANSFORMS **9+3**

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 ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

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OUTCOMES:

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions. Students will be able to solve problems related to engineering applications by using these techniques.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition, 2011.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.

REFERENCES:

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

CY8201 CHEMICAL REACTIONS DYNAMICS L T P C
3 0 0 3

OBJECTIVE:

To study the kinetics and solid state chemistry.

UNIT I SOLID STATE CHEMISTRY 9

Solids - types - crystalline, amorphous and polycrystalline properties. Isotropy and anisotropy-interfacial angles - symmetry in crystal systems - elements of symmetry, - space lattice and unit cell, Bravias lattices - seven crystal systems. Types of bonds - molecular, covalent, metallic and ionic. Born-Haber Cycle, Lattice energy, Imperfections in a crystal- Stoichiometric defects - Schottky, Frenkel. Non-stoichiometric defects – colour Centre, F-Centre.

UNIT II REACTION KINETICS IN SOLUTIONS 9

Determination of rate laws: Integral, Isolation, half-life and differential methods; comparison of different techniques. Kinetic equations for complex reactions-chain, parallel, opposing and consecutive reactions; Theory of reaction rates; Temperature effect on reaction rates; Rate constant for simple bimolecular reactions; Collision theory; Activated complex theory. Reactions in solutions: Diffusion controlled and activation controlled reactions; Thermodynamic formulation of rate constant: effect of pressure and ionic strength.

UNIT III REACTION KINETICS ON SURFACES **9**

Adsorption: Adsorption of gases by solids - factors influencing adsorption. Langmuir adsorption; Adsorption of solutes from solutions - Freundlich adsorption. Applications - Adsorption Chromatography (Column Chromatography). kinetics of surface catalyzed unimolecular and bimolecular reactions; Applications in ammonia synthesis and oxidation of carbon-monoxide.

UNIT IV KINETICS OF SOLID STATE REACTIONS **9**

Solid State Reactions: Types; sintering; nucleation; Factors influencing the reactivity of solids; Precursors to solid state reactions; Tammann and Hedvall mechanism; Wagner's diffusion theory, Material transport in solid state reaction-counter diffusion, Kirkendall effect; Huttig's mechanism; Kinetic model-Reaction in powder compact, parabolic rate law, Jander's rate equation. Atomic theory of diffusion- self diffusion mechanism.

UNIT V PREPARATIVE METHODS **9**

Vapour phase transport, preparation of thin films - electrochemical methods, chemical vapour deposition; Crystal growth- Bridgman and Stokbarger methods, zone melting, High Temperature Ceramic Methods, Particle size reduction, precursor method, co-precipitation, sol-gel, Microwave Synthesis, Combustion Synthesis, High Pressure Methods, preparing single crystals - Czochralski, molecular beam epitaxy - temperature gradients, flame and plasma fusion, solution methods, Intercalation.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to understand fundamentally kinetics and solid state chemistry

TEXT BOOKS:

1. K.J. Laidler, Chemical Kinetics, 4th Edn. Pearson Educations, New Delhi, 2007.
2. A.R. West, Solid State Chemistry and its Applications, 1st Edn. John Wiley, Singapore, 1998.

REFERENCES:

1. M.J. Pilling and P. W. Seakins, "Reaction Kinetics" 1st Edn. Oxford University Press, London, 1995.
2. Sandra E. Dann, "Reactions and Characterization of Solids", 1st Edn. The Royal Society of Chemistry, Cambridge, 2000.
3. Leslie E. Smart and Elaine A. Moore "Solid State Chemistry: An Introduction", 3rd Edn. Taylor & Francis, New York, 2005.

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GE8251 **ENGINEERING MECHANICS** **L T P C**

3 1 0 4

OBJECTIVE:

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

UNIT I BASICS & STATICS OF PARTICLES **12**

Introduction – Units and Dimensions – Laws of Mechanics – Lame'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 EQUILLIBRIUM OF RIGID BODIES **12**

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 **12**

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 **12**

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 ELEMENTS OF RIGID BODY DYNAMICS **12**

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 disc/wheel and sphere.

TOTAL: 60 PERIODS

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OUTCOMES:

- ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
- ability to analyse the forces in any structures.
- ability to solve rigid body subjected to dynamic forces.

TEXT BOOkS:

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

ME8251 DESIGN CONCEPTS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To impart the importance of design in today's context of global competition, environmental awareness and customer oriented market.
- To impart the basic concepts and various aspects of design using simple examples and case studies.

UNIT I DESIGN TERMINOLOGY 9

Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.

UNIT II DESIGN PROCESS 9

Basic module in design process-scientific method and design method-Need identification, importance of definition of problem-structured problem, real life problem- gathering information-customer requirements- Quality Function Deployment (QFD)- product design

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specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation (Basics only)

UNIT III CREATIVITY IN DESIGN **9**

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks-Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition-creating design concepts.

UNIT IV HUMAN AND SOCIETAL ASPECTS **9**

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects-environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects.

UNIT V MATERIAL AND PROCESSES IN DESIGN **9**

Material selection for performance characteristics of materials-selection fro new design-substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for manufacturability (DFM) - Design for assembly (DFA).

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to comprehend the steps in the new product design
- Understanding of customer equipments for new product and making specifications.
- Knowledge in the role of creativity in product design
- Ability to decide materials and processes in product development.

TEXTBOOK:

1. George E.Dieter , “Engineering Design: A Materials and Processing Approach” 4th Edition, Tata McGraw Hill, 2008

REFERENCES:

1. Joseph E.Shigley, Charles R.Mische ,”Mechanical Engineering Design”, McGraw Hill International edition, 6th Edition 2009
2. Edward B.Magrab, “Integrated Product and Process Design and Development” CRC Press, 1997
3. James Garratt,” Design and Technology”, 2nd Revised Edition, Cambridge University Press,1996.

ML8201 STRUCTURE AND PROPERTIES OF MATERIALS 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 10

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 10

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 Titanium alloys, Nickel alloys, Copper alloys, Magnesium alloys and Aluminium alloys.

UNIT IV CERAMIC AND COMPOSITE MATERIALS 8

Types - Crystal Structures - Silicate Ceramics - Glasses – Glass Ceramics – Advanced ceramics-Functional properties and applications of ceramic materials – Super hard materials - Tungsten carbide and Boron nitrides – Graphene.

Classification of Composites - Fibre reinforced materials – Law of mixtures – Continuous fibres – Discontinuous fibres – Particle-reinforced composites – Cermets – Dispersion strengthened materials – Structural composites- Laminar – Sandwich panel-Application of composites in various fields of technology-Smart Composites

UNIT V POLYMERS AND ELASTOMERS 8

Classification of polymer – Mechanisms of polymerisation – Copolymers – Examples- Defects in polymers- Thermoplastics - Thermosets – Engineering plastics - Advanced Polymeric materials -Liquid crystal polymers - Conductive polymers – High Performance fibres– Photonic

polymers- -Elastomers- Applications.

TOTAL: 45 PERIODS

OUTCOMES:

- Recognise basic nomenclature, basic microstructure, associate terms with the appropriate structure / phenomena and be able to differentiate between related structure / phenomena.
- Perform simple calculations to qualify materials properties and microstructural characteristics.
- Recognise the effect of composition and microstructure on material properties.
- Ability to perform phase equilibrium calculation and construct phase diagram.
- Select suitable ferrous and non-ferrous materials for Engineering application.

TEXTBOOkS:

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

REFERENCES:

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

CY8212 **CHEMICAL ELEMENT ANALYSIS LAB** **L T P C**
0 0 3 2

OBJECTIVE:

To familiarise students on methods of determination of composition of different materials by wet chemical methods.

LIST OF EXPERIMENTS

1. Determination of Cu in Brass Sample.
2. Determination of Fe in Iron Ore.
3. Determination of Mn in Steel.
4. Determination of Cr in steel.
5. Determination of Si in cast iron.
6. Determination of carbon and sulphur in steel.
7. Determination of Ca in Limestone.
8. Identification of functional groups in organic compounds
9. Identification of monomers in polymers

TOTAL: 45 PERIODS

OUTCOME

- This lab is about the quantitative and qualitative analysis of chemical elements. The student will able to identify and determine the specific element present in the given material sample (metal alloy, ceramics and organic compounds).

ML8211 **MICROSTRUCTURAL ANALYSIS LAB** **L T P C**
0 0 3 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

TOTAL: 45 PERIODS

OUTCOME

The student will obtain knowledge on the microstructural analysis of various metals and alloys with regard to sample preparation via polishing and etching and use and analysis of optical microscopy.

MA8352 APPLIED STATISTICS L T P C

(Branch specific course in III or IV Semester) 3 1 0 4

OBJECTIVES:

- To make the students acquire a sound knowledge in statistical techniques that model engineering problems.

UNIT I TESTING OF HYPOTHESIS 9+3

Sampling distributions-Tests for single mean, proportion and difference of means, proportions (large and small samples)-Tests for single variance and equality of variances-χ 2 -test for goodness of fit- Independence of attributes.

UNIT II NON-PARAMETRIC TESTS 9+3

Advantages and drawbacks over parametric methods-Sign test-Median test-Mann-Whitney Wilcoxon u-test-Wald-Wolfowitz run test.

UNIT III DESIGN OF EXPERIMENTS 9+3

Completely randomized design-Randomized block design-Latin square design -22 factorial design-Taguchi's robust parameter design.

UNIT IV STATISTICAL QUALITY CONTROL 9+3

Control charts for variables-Control charts for attributes-Tolerance limits-Acceptance sampling by attributes.

UNIT V TIME SERIES 9+3

Components of time series-Analysis of time series-Measurement of trend-Measurement of seasonal fluctuations.

TOTAL: 60 PERIODS

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OUTCOMES:

After successfully completing the course, students should be able to do the following:

- Use statistical methodology and tools in the engineering problem-solving process.
- Compute and interpret descriptive statistics using numerical and graphical techniques.

TEXT BOOkS:

1. Walpole R.E., Myers R.H., Myers S.L. and Keying Ye., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th edition, 2007.
2. Gupta S.C. and Kapoor V.K., "Fundamentals of Applied Statistics", Sultan Chand and Sons, Reprint, New Delhi, 2nd edition, 2002.

REFERENCES:

1. Johnson R.A., "Miller and Freund's Probability and Statistics for Engineers", PHI Learning Pvt. Ltd., New Delhi, 8th edition, 2011.
2. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/ Cole, International Student Edition, New Delhi, 7th edition, 2008.
3. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4th edition, 2007.

CY8302 POLYMER SCIENCE AND 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:

- Use of techniques for polymer processing.
- Ability to develop structure – property relationship in polymer.

TEXTBOOkS:

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
6. Systems, 5th edition, Taylor and Francis, 2003.
7. Crawford R.J, Plastics Engineering (3rd Ed), Pergamon Press, London (1987)

CE8353 **STRENGTH OF MATERIALS** **L T P C**
3 0 0 3

OBJECTIVE:

- To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

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 – Volumertric 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 Theorems 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 cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theory – Application of theories of failure.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply mathematical knowledge to calculate the deformation behavior of simple structures.
- Critically analyse problem and solve the problems related to mechanical elements and analyse the deformation behavior for different types of loads.

TEXT BOOkS:

1. Bansal, R.K., Strength of Materials, Laxmi Publications (P) Ltd., 2007
2. Jindal U.C., Strength of Materials, Asian Books Pvt. Ltd., New Delhi, 2007

REFERENCES:

1. Egor. P.Popov " Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2. Subramanian R., Strength of Materials, oxford University Press, Oxford Higher Education

Series, 2007.

3. Hibbeler, R.C., Mechanics of Materials, Pearson Education, Low Price Edition, 2007
4. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole Mechanics of Materials, Tata Mcgraw Hill publishing 'co. Ltd., New Delhi.

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, d esigning 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 10

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 – Gear manufacturing.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and perform basic casting processes.
- Ability to design casting and select suitable casting process for different materials.
- Ability to perform basic maching 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.
2. P.L. Jain, “Principles of Foundry Technology”, Tata-McGraw Hill, 2003.

REFERENCES:

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

ML8302 SOLID STATE PHYSICS L T P C
3 1 0 4

OBJECTIVE:

- This subject provides the insight to physics of material starting with basics of matter waves, lattice vibrations and band theories to understand properties of metals, semiconductors, electric conductors, dielectrics, ferroelectrics, superconductors and thermal properties of materials

UNIT I INTRODUCTION TO MODERN PHYSICS AND LATTICE DYNAMICS 12

Matter waves – Heisenberg’s uncertainity principle - Schrodinger’s time independent wave equation – Physical significance of wave function (y) – Application to a particle in a one dimensional box (infinite potential well)- Interatomic forces and lattice dynamics and simple metals, ionic and covalent crystals. Elastic waves in one dimensional array of identical atoms, vibrational modes of a diatomic linear lattice and dispersion relations, acoustic and optical modes, phonon dispersion relation.

UNIT II BAND THEORY OF SOLIDS AND SEMICONDUCTOR PHYSICS 12

Fermi- Dirac distribution function, density of states, temperature dependence of Fermi energy, specific heat, use of Fermi- Dirac statistics in the calculation of thermal conductivity and electrical conductivity, Widemann -Franz ratio, susceptibility, width of conduction band,

Drude theory of light, absorption in metals. Bloch theorem. Behaviour of electrons in periodic potentials, Kronig-Penny model, E vs k relation, Density of states in a band, effective mass of electron, physical basis of effective mass, Intrinsic semiconductors. Band model, Fermi level, Expressions for electron and hole concentration in intrinsic and extrinsic semiconductors, Thermal ionization of impurities, Hall effect in semi conductors (p-type and n-type).

UNIT III DIELECTRICS AND FERROELECTRICS 12

Macroscopic description of the static dielectric constant. The electronic and ionic polarizabilities of molecules, orientational polarization, Measurement of the dielectric constant of a solid. Theinternal field of Lorentb, Clausium-Mosotti relation. Behaviour of dielectrics in an alternating field, elementary ideas on dipole relaxation, classification of ferroelectric crystals - $BaTiO_3$ and KDP. Thermodynamics of ferroelectric crystals - Devonshire theory.

UNIT IV MAGNETISM 12

Larmor diamagnetism. Paramagnetism, Curie Langevin and Quantum theories. Susceptibility of rare earth and transition metals. Ferromagnetism : Domian theory, Weiss molecular field and exchange, spin waves: dispersion relation and its experimental determination by inelastic neutrons scattering, heat capacity. Nuclear Magnetic resonance: Conditions of resonance, Bloch equations

UNIT V SUPERCONDUCTIVITY 12

Occurrence of superconductivity, Destruction of superconductivity by magnetic fields Meissner effect, Heat capacity, Energy gap and Isotope effect. London's equations, Penetration depth, Coherence length, Cooper-pairs; elements of BCS theory, Giaver tunneling, Josephson effects (basic ideas), Elements of high temperature superconductivity (basic concepts only).

TOTAL: 60 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use semiconductor materials for the application.

TEXTBOOKS:

1. S. O. Pillai," Solid state physics", New age International Pvt Ltd, 6th edition, 2005
2. Wahab, M. A.," Solid State Physics", Narosa Publishing, 2nd Edition, 2005

REFERENCES:

1. Charles Kittel.," Introduction to Solid State Physics", John Wiley, 8th edition, 2005.
2. Ibach, Harald, Lüth, Hans," An Introduction to principles of Materials Science", Springer, 2003.
3. James D. Patterson, Bernard C. Bailey," Solid State Physics: Introduction to the theory", Springer-Verlag, edition 1, 2005
4. Mckelvy, J. P.," Solid State and Semi-conductor Physics", Harper International, 1966

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5. Federick Reif,“ Fundamentals of Statistical and Thermodynamical Physics”, McGraw-Hill, 1965

ML8303 THERMODYNAMICS OF MATERIALS L T P C
3 0 0 3

OBJECTIVE:

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

UNIT I FUNDAMENTAL CONCEPTS 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

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 AUxILLARY FUNCTIONS AND THERMODYNAMIC POTENTIALS 10

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 10

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 10

Thermodynamics of electrochemical cells, solid electrolytes. 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: 45 PERIODS

OUTCOMES:

- A fundamental understanding of the first and second laws of thermodynamics and their application to a wide range of system.
- The student should be able to use thermodynamics on solid state equilibrium as well as o equilibrium between solids and gasses

TEXTBOOKS:

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

REFERENCES:

1. Prasad, Krishna Kant, Ray, H. S. and Abraham, K. P., "Chemical and Metallurgical Thermodynamics", New Age International, 2006
2. Upadhyaya, G. S. and Dube, R. K., "Problems in Metallurgical Thermodynamics and Kinetics", Pergamon Press, London, 1977.
3. Thomas Engel, Philip Reid, Thermodynamics, Statistical Thermodynamics and Kinetics, Pearson Education (LPE) 2007.
4. Ahindra Ghosh, Textbook of Materials and Metallurgical Thermodynamics, Prentice hall of India, 2003.
5. Peter Atkins, Julio de Paula, Physical Chemistry Volume 1: Thermodynamics and Kinetics, W. H. Freeman & Company, 2010
6. DeHoff R T, Thermodynamics in Materials science, McGrawhill, Newyork 1993.
7. J J Moore, "Chemical Metallurgy", Butterworth-Heinemann Ltd, 1990.
8. David V Ragone, "Thermodynamics of Materials - Volume-1", John Wiley & Sons, Inc. 1995.
9. Darken LS and Gurry R W ,"Physical Chemistry of Metals", McGraw Hill, 1987.
10. Swalin R A, "Thermodynamics of solids", John Wiley Sons Inc, third edition, 1966.

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CE8362 STRENGTH OF MATERIALS LABORATORY L T P C
0 0 3 2

OBJECTIVES:

To study the properties of materials when subjected to different types of loading.

LIST OF EXPERIMENTS

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

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to perform different destructive testing
- Ability to characteristic materials

REFERENCE:

1. Relevant Indian Standards

ML8311 FOUNDRY PRACTICES LABORATORY L T P C
0 0 3 2

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

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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 Compactibility.
10. Metal Casting by Green sand and full mould process.

TOTAL: 45 PERIODS

OUTCOME

- This course will enable the student to know typical process of foundry covering melting of various metals, sand mould preparation and also the different testing methods .

ML8312 MANUFACTURING TECHNOLOGY LABORATORY L T P C
0 0 3 2

OBJECTIVE:

Student should have knowledge on common basic machining operations which can be carried out in general purpose and Special Purpose Machine Tools.

LIST OF EXPERIMENTS

1. Machining practice in lathe: Taper Turning, Thread Cutting, Eccentric Turning and Knurling
2. Study of Turret and Capstan lathe
3. Machining practice in Shaper: Square and Hexagonal Shaping
4. Drilling and Tapping
5. Determination of Cutting forces in Turning and Milling Operations.
6. Machining practice in Horizontal and Vertical Milling machine: Polygonal milling, contour milling, spur and helical gear milling
7. Gear generation by Hobbing & Shaping
8. Machining practice in Grinding: Cylindrical, Surface, Tool and Cutter Grinding
9. Spur and helical gear cutting in Milling Machine.

TOTAL: 45 PERIODS

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OUTCOME

- The student will gain knowledge on various machining operations and will have some hands on experience in machining operations like work piece mounting, tool selection, operating conditions for a process and cross check the dimensions of the machined component.

GE8351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES

To the study of nature and the 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 – soil 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.

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

REFERENCE BOOKS

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2 Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico

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Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD,New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

ME8452 MECHANICS OF MACHINES L T P C
3 0 0 3

OBJECTIVES:

- To understand the principles in the formation of mechanisms and their kinematics.
- To understand the effect of friction in different machine elements.
- To analyze the forces and torque acting on simple mechanical systems
- To understand the importance of balancing and vibration.

UNIT I KINEMATICS OF MECHANISMS 9

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

UNIT II GEARS AND GEAR TRAINS 9

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT V FRICTION IN MACHINE ELEMENTS 9

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes – Friction in vehicle propulsion and braking.

UNIT IV FORCE ANALYSIS 9

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members.

UNIT V BALANCING AND VIBRATION 9

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation.

TOTAL : 45 PERIODS

OUTCOME

- The course will enable the student to understand the forces and torque acting on simple mechanical systems and also the importance of balancing and vibration and the effect of friction in different machine parts of practical significance.

TEXT BOOk:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms",3rdEdition, Oxford University Press, 2009.

REFERENCES:

1. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.
2. Thomas Bevan, 'Theory of Machines', 3rd Edition, CBS Publishers and Distributors, 2005.
3. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
4. Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2nd Edition, 2007
5. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
6. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
7. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines', Affiliated East-West Pvt. Ltd., New Delhi, 1988.
8. Rao.J.S. and Dukkipati.R.V. 'Mechanisms and Machine Theory', Wiley-Eastern Ltd., New Delhi, 1992.
9. John Hannah and Stephens R.C., 'Mechanics of Machines', Viva Low-Prices Student Edition, 1999.
10. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996
11. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "**Theory of Vibration with Application",** 5th edition Pearson Education, 2011
12. V.Ramamurthi, Mechanics of Machines, Narosa Publishing House, 2002.
13. Khurmi, R.S.,"Theory of Machines",14th Edition, S Chand Publications.

STANDARDS:

1. IS 2458 : 2001, Vocabulary of Gear Terms – Definitions related to Geometry.
2. IS 3756 : 2002, Method of Gear Correction – Addendum modification for External cylindrical gears with parallel axes.
3. IS 5267 : 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.
4. IS 12328 : Part 1: 1988 Bevel Gear Systems Part – 1 Straight Bevel Gears.
5. IS 12328 : 1988 Bevel Systems Part – 2 Spiral Bevel Gears.

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ML8401 ANALYTICAL INSTRUMENTATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVE:

To have thorough understanding of theory, instrumentation and applications of analytical equipments used for chemical analysis.

UNIT I INTRODUCTION TO SPECTRAL METHODS 9

Molecular and atomic spectroscopy-interaction of electromagnetic radiation with matter-Energy levels in atoms and molecules – Absorption techniques and emission techniques: fluorescence, phosphorescence and chemiluminescence – Beer-Lambert law; qualitative and quantitative analyses – limitations – visible absorption spectroscopy.

UNIT II UV AND VISIBLE SPECTROCOPY 9

Electronic transitions and energy level diagrams, Choice of solvents, cut off wavelengths for solvents, Woodward –Fieser rules for the calculation of absorption maxima, Effects of conjugation and solvent polarity on the absorption maxima. Instrumentation for UV and Visible spectrophotometers - source, optical parts and detectors. Photometric titration - experimental setup and various types of titrations and their corresponding curves. Applications of UV and Visible spectrophotometry.

UNIT III IR , RAMAN AND ATOMIC SPECTROSCOPY 9

Theory of IR spectroscopy, Various stretching and vibration modes for diatomic and triatomic molecules (both linear and nonlinear), various ranges of IR and their usefulness, Instrumentation (sources, optical path and detectors used in different regions), sample preparation techniques, Applications. Raman spectroscopy: Theory, Differences between IR and Raman. Atomic absorption spectrophotometry: Principle, Instrumentation, types of fuels, Hollow cathode lamp, detector and applications, Flame photometry: Principle, Instrumentation and applications in quantitative analysis – ICP-AES: Instrumentation and applications.

UNIT IV SEPARATION TECHNIQUES 9

Solvent extraction and ion exchange techniques –principles and applications; Chromatographic techniques – adsorption chromatography, thin layer chromatography, gas chromatography, high performance chromatography. Separation of organic compounds by column and thin layer and paper chromatographic techniques. Qualitative and quantitative analyses by GC and HPLC.

UNIT V THERMAL AND SURFACE ANALYTICAL METHODS 9

Thermal analytical techniques- TGA, DTA, DSC – principles, instrumentation and applications; Surface analysis – TEM, SEM and AFM – Principles, instrumentation and applications.

TOTAL: 45 PERIODS

OUTCOME

- This subject familiarize the students about the principle and working of various sophisticated instruments (FTIR, UV vis, Raman, AAS, Flame photometry, ICP-AES, HPLC, GC, TGA,DSC and DTA; TEM, SEM and AFM) and their use in material analysis.

TEXTBOOKS:

1. D. A. Skoog, F. James Leary and T. A. Nieman, “Principles of Instrumental Analysis”, Fifth Edition, Saunders Publishing Co., 1998
2. D.A. Skoog, F.J. Holler and S.R. Crouch, “Principles of Instrumental Analysis” 6th Edition, Thomas Brookes/Cole, 2007

REFERENCES:

1. Willard, H.H., Merritt.l.l., Dean J.a., and Settle,F.A., Instrumental methods of analysis, Sixth edition, CBS publishers,1986.
2. F.W. Fifield and D. Kealey, “Principles and Practice of Analytical Chemistry, 1st Indian Reprint, Blackwell Pub., 2004.
3. J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar., “Vogel’s Text Book of Quantitative chemical analysis” , 6th Edition, Pearson, 2009.
4. Day R.A Underwood A.L Qualitative Inorganic analysis (A. I. Vogel). V Edition, Prentice- Hall of India (P) Ltd, NewDelhi.
6. G.D Christian, “ Analytical Chemistry” , 6th Edn., John Wiley Press (2006).
6. Sharma, B.K., Instrumental Methods of Analysis, Goel publishing House,1995
7. Kalsi .P.S. Spectroscopy of organic compounds, 6th Edition, New Age International Publishers,2006
8. William Kemp, Organic Spectroscopy, 3rd Edition, Palgrave publishers, 2007

ML8402 IRON AND STEEL MAKING L T P C
3 0 0 3

OBJECTIVE:

- The course covers the production of iron and steel from raw material, primary processing torefinement 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

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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 10

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 STEELS AND CAST IRON LADLE METALLURGY 8

Production practice for plain carbon steels, low alloy – Cast irons and ductile iron, 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

OUTCOME

- The course will enable the student to gain knowledge on the production processes of steel and iron. The student will understand the kinetics involved in the production of iron and steel. The student also gains knowledge on the refinement of steels to obtain a quality product.

TEXTBOOKS:

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. Biswas, A. K., “Principles of blast furnace iron making: theory and practice”, SBA Publications, Kolkata, 1994.
2. Bashforth, G. R., “Manufacture of Iron and Steel”, Vol. I, Chapman and Hall London, 1964.
3. Bashforth, G. R., “Manufacture of Iron and Steel”, Vol.2, 3rd Edition, Chapman & Hall, London, 1964.
4. “Making, Shaping and Treating of Steel”, US Steel Corporation, 11th edition, 1994.
5. Ahindra Ghosh and Amit chatterjee, “Iron Making and Steel Making – Theory and Practice”, Prentice Hall of India Private Ltd., New Delhi 2008.

ME8403 **MECHANICAL METALLURGY** **L T P C**
3 0 0 3

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**

Elastic behaviour 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 **10**

Elementary discussion of cold working, grain boundary strengthening. Solid solution strengthening, Martensitic strengthening, Precipitation strengthening, Particulate Strengthening, Dispersion strengthening, Fiber strengthening, Examples of above strengthening mechanisms from ferrous and non-ferrous systems, Yield point phenomenon, strain aging and dynamic strain aging

UNIT III FRACTURE AND FRACTURE MECHANICS **9**

Types of fracture, Basic mechanisms 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 KIC, Introduction to COD, J integral.

UNIT IV FATIGUE BEHAVIOUR AND TESTING **8**

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- Pari's Equation, Residual life prediction under Fatigue.

UNIT V CREEP BEHAVIOUR AND TESTING **9**

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, Parametric methods of extrapolation. Deformation Mechanism Maps according to Frost/Ashby.

TOTAL: 45 PERIODS

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OUTCOMES

- Students will demonstrate and understanding of the mechanical properties and behaviour of materials.
- In the concept of linear elastic fracture mechanics and estimate the effects of cracks in material and structure.
- Students will demonstrate the ability to identify engineering problem in using plastic deformation, fatigue, fracture and creep
- Assues and describe the mechanism loading to failure when provided with a failure example.

TEXTBOOkS:

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

REFERENCES:

1. Wulff, "The Structure and Properties of Materials, Vol. III - Mechanical Behaviour of Materials", John Wiley and Sons, New York, USA, 1983.
2. Honeycombe R. W. K., "Plastic Deformation of Materials", Edward Arnold Publishers, 1984.
3. Suryanarayana, A. V. K., "Testing of Metallic Materials", Prentice Hall India, New Delhi, 1979.
4. Prashant Kumar, "Elements of Fracture Mechanics", McGraw-Hilll, 2009.
5. Thomas H.Courtney, " Mechanical Behaviour of Materials", McGraw-Hilll, Boston, 2nd edition, 2000.

ML8404 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 atomisation 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

Pressureless 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 8

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 10

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:

- Upon completion of this course, the students can able to apply the student will have knowledge about powder metallurgical material and their fabrication processes.

TEXTBOOKS:

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

REFERENCES:

1. Sinha A. K., "Powder Metallurgy", Dhanpat Rai & Sons. New Delhi, 1982
2. R.M. German, "Powder Metallurgy and Particulate Materials Processing", Metal Powder Industries Federation, Princeton, NJ, 2005.
3. ASM Handbook. Vol. 7, "Powder Metallurgy", Metals Park, Ohio, USA, 1990.

4. Animesh Bose., “Advances in Particulate Materials”, Butterworth - Heinemann. New Delhi, 1995.
5. Kempton. H Roll., “Powder Metallurgy”, Metallurgical Society of AMIE, 1988.
6. Ramakrishnan. P., “Powder Metallurgy-Opportunities for Engineering Industries”, Oxford and IBH Publishing Co., Pvt. Ltd, New Delhi, 1987.
7. Erhard Klar., “Powder Metallurgy Applications, Advantages and Limitations”, American Society for Metals, Ohio, 1983.
8. Sands. R. L. and Shakespeare. C. R. “Powder Metallurgy”, George Newes Ltd. London, 1966

ML8411 ANALYTICAL INSTRUMENTION LABORATORY L T P C
0 0 3 2

OBJECTIVE

This laboratory course offers practical knowledge of analytical instruments to evaluate and analyse the samples.

LIST OF EXPERMENTS:

1. Precision and validity in an experiment using absorption spectroscopy
2. Validating Lambert-Beer’s law using KMnO4
3. Finding the molar absorbtivity and stoichiometry using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectroscopic techniques
6. Chromatography analysis using TLC.
7. Chromatography analysis using Column chromatography.
8. Determination of conductivity
9. Determination of vibration band Fourier Transform Infrared Spectroscopy.
10. Determination of decomposition of materials using Thermogravimateric Analysis – Differential Thermal Analysis-Differential scanning calorimetry.
11. Determination of Coefficient of Expansion of material using dilatometer.

TOTAL : 45 PERIODS

OUTCOME

- This lab enable student to select analytical technique to evaluate and analyse the samples. Students learn to use the instruments and get exposed to specimen preparation, validation of instrument, precise use of instrument to accurately estimate the given samples.

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ML8412 POWDER METALLURGY LABORATORY L T P C
0 0 3 2

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. Fracture Toughness determination of sintered product.
9. Preparation of porous ceramic product.

TOTAL : 45 PERIODS

OUTCOME

- The course will enable a student to understand and carryout powder metallurgy route involving synthesis, compaction , sintering and appropriate testing methods.

ME8553 MACHINE DESIGN L T P C
3 1 0 4

OBJECTIVES:

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

UNIT I STEADY STRESSES IN MACHINE MEMBERS 10

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

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UNIT II SHAFTS, COUPLINGS, JOINTS AND BEARINGS 8

Design of solid and hollow shafts based on strength, rigidity and critical speed –Keys, key ways and splines –Rigid and flexible couplings.

Threaded fasteners, Welded joints and riveted joints for structures, Sliding contact and rolling contact bearings (Simple problems)

UNIT III ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9

Various types of springs, optimization of helical springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

UNIT IV DESIGN FOR FLEXIBLE ELEMENTS 9

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

UNIT V SPUR GEARS, HELICAL GEARS AND GEAR BOXES 9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations.

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

TOTAL: 60 PERIODS

Note: (Use of P S G Design Data Book is permitted in the University examination)

OUTCOMES:

- Upon completion of this course, the students can able to successfully design machine components

TEXT BOOK:

1. Bhandari V, “Design of Machine Elements”, 3rd Edition, Tata McGraw-Hill Book Co, 2010.

REFERENCES:

1. Sundararajamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.
2. Joseph Shigley,Charles Mischke,Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill , 2008.
3. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”,4th Edition, Wiley, 2005
4. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill Book Co.(Schaum’s Outline), 2010

5. Bernard Hamrock, Steven Schmid, Bo Jacobson, “Fundamentals of Machine Elements”, 2nd Edition, Tata McGraw-Hill Book Co., 2006.
6. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
7. Ansel Ugural, “Mechanical Design – An Integral Approach, 1st Edition, Tata McGraw-Hill Book Co, 2003.
8. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.

STANDARDS:

1. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 1 : Construction.
2. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 2 : Friction and Wear.
3. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 3: Lubrication.

ML8501 CHARACTERISATION 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 8

Macroexamination -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 10

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.

Attested

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UNIT 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 SURFACE ANALYSIS 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).

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to perform analysis of X ray diffraction and electon microscope images and the chemical and thermal analysis datas.

TEXTBOOKS:

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

REFERENCES:

1. Brandon D. G, "Modern Techniques in Metallography", VonNostrand Inc. NJ, USA, 1986.
2. Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996.
3. Weinberg, F., "Tools and Techniques in Physical Metallurgy", Volume I & II, Marcel and Decker, 1970.
4. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterisation ", Nineth edition, ASM international, USA, 1986.
5. Haines, P.J.," Principles of Thermal Analysis and Calorimetry", Royal Society of

Chemistry (RSC), Cambridge, 2002.
6. D. A. Skoog, F. James Leary and T. A. Nieman, “Principles of Instrumental Analysis”, Fifth Edition, Saunders Publishing Co., 1998

ML8502 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 10

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 – habit plane – Bain distortion model

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 welding – principles – methods – operating variables, measurement of case depth

UNIT IV FURNACES, ATMOSPHERE AND PROCESS CONTROL 8

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, 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, HSLA 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:

- Ability to select and perform heat treatment for different ferrous and non-ferrous alloy.
- ability to identify the microstructure and analyse different phase after heat treatment.

TEXTBOOKS:

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

REFERENCES:

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

ML8503 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 make use of mechanical and thermodynamics principle of plastic deformation to form the components using different techniques.

TEXT BOOkS:

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

REFERENCES:

1. Kurt Lange, “Handbook of Metal Forming”, Society of Manufacturing Engineers, Michigan, USA, 1998.
2. Nagpal G. R., “Metal Forming Processes”, Khanna Pub., New Delhi, 2000
3. Avitzur, “Metal Forming – Process and Analysis”, Tata McGraw – Hill Co., New Delhi, 1977.
4. Shiro Kobayshi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1987.

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5. Dr.Sadhu Singh, “Theory of plasticity and Metal Forming Processes”, Khanna Publishers, 2005.

ML8511 HEAT TREATMENT LABORATORY L T P C
0 0 3 2

OBJECTIVE:

This laboratory course offers practical knowledge of heat treatment applicable to Ferrous as well as Non-Ferrous materials and studies microstructural 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 : 45 PERIODS

OUTCOMES:

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

ML8512 METAL FORMING LABORATORY L T P C
0 0 3 2

OBJECTIVE:

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

LIST OF EXPERIMENTS:

1. Formability of sheet metal by Ericsson cupping test
2. Construction of Formability limit diagram

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3. Water hammer test
4. Ring Compression test
5. Diameter reduction in Wire drawing
6. Deep drawing for simple cup shape
7. Extrusion of Cylindrical component
8. Thickness reduction in Sheet metal rolling.
9. Study of Sheet metal forming using FEA analysis software
10. Study of Super plastic forming Process

TOTAL : 45 PERIODS

OUTCOMES:

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

ME8652 INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

To develop modern concepts of Industrial Management

UNIT I INTRODUCTION 9

Technology 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 – Line and functional Managers, Constraints – Environmental – Financial – Legal- 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 inventory management systems-Tools of Techniques– Prevention control, industrial safety

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UNIT III ORGANIZATIONAL BEHAVIOUR **9**

Definition – Organization – Managerial Role and functions – organizational approaches, individual behavior – 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, Organizational 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) – Strategic Management – SWOT analysis – Evolving development strategies, information technology in management – Decision support system – Management Games – Business Process Re-engineering (BPR) – supply chain management (SCM) –Global Perspective – Principles and Steps – Advantages and Disadvantages

TOTAL:45 PERIODS

OUTCOME

- The course will enable student preparedness to technology management and the forms of organisation in an industry. This course also enables the student to understand the functions of Management and also the organisational behaviour. It also gives some knowledge on the modern concepts such as Strategic management, SWOT analysis, Business Process Re-engineering (BPR) and supply chain management (SCM).

TEXT BOOkS:

1. Herald Koontz and Heinz Weihrich, 'Essentials of Management', McGraw Hill Publishing Company, Singapore International Edition, 1980.
2. M.Govindarajan and S.Natarajan, Principles of Management, Prentice Hall of India Pvt.Ltd. New Delhi 2007

REFERENCE BOOkS:

1. S.Chandran, Organizational Behaviors, Vikas Publishing House Pvt., Ltd, 1994
2. Ties, AF,Stoner and R.Edward Freeman, 'Management' Prentice Hall of India Pvt. Ltd. New Delhi 110011, 1992.
3. Joseph J,Massie, 'Essentials of Management' Prentice Hall of India. Ltd. 1985

ML8601 CERAMIC SCIENCE AND TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

The subject is intending to inoculate the basics of conventional, functional ceramics, etc., method of preparation, fabrication and testing for engineering application.

UNIT I INTRODUCTION 9

Review of bonding types in ceramics – calculation of percentage ionic character. Types of ceramcis, Ceramic crystal structures: Sodium chloride, cesium chloride, alumina, spinel and fluorite structures - examples. Co-ordination number and ionic radius ratio - Pauling's Rules. Simple problems involving Packing Fraction, critical radius ratio and density.

UNIT II PROPERTIES AND APPLICATIONS OF ENGINEERING CERAMICS 9

Ceramics for mechanical functions: Abrasives - properties and applications SiC, Cubic Boron Nitride (CBN) - properties and applications. Ceramics for electrical and insulating functions - Barium Titanate and its modifications - insulating porcelains - properties and applications. Ceramics for magnetic functions - Normal and inverse spinel structure - Zinc, Nickel, Manganese and Iron ferrites - structure properties and applications Ceramics for thermal functions: Refractories - Desirable characteristics - applications - Ceramics for nuclear applications.

UNIT III PREPARATION AND FORMING OF CERAMICS 9

Preparation of Alumina, Zirconia, Silicon carbide, Silicon Nitrides, Boron Nitride, Brief description of slip and slurry casting - applications. Powder processing equipment and proc ess details of hot pressing, Hot Isostatic Pressing and Cold Isostatic Pressing. Liquid Phase sintering. shock wave compaction, reaction sintering, cermets

UNIT IV GLASSES 9

Types of glasses - structure, properties and applications of various types of glasses. Silicate-Glass ceramics- heat flow and precipitation from glasses – growth controlled by diffusion of solutes – crystalline glasses – enamels – photosensitive and photochromic glasses ; Blowing, pressing, drawing, rolling and casting - Pilkington process for float glass.

UNIT V PROPERTY EVALUATION 9

Rupture strength, fracture Toughness, Elastic Constants, Hardness, Creep, Thermal Property-Coefficient of thermal expansion, Electronic Property, Measurement of electro-optic properties-Weibull Statistics of Strength Data for Fine Ceramics.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course the students can able to do the method of preparation, fabrication and testing for engineering application.

TEXT BOOkS:

1. Michael Barsoum, “Fundamentals of Ceramics”, Mc Graw Hill Publishing Co., INC, 1997.
2. William F.Smith, “Foundations of Materials Science and Engineering”, Second Edition, McGraw- Hill Inc, New York, 1993.

REFERENCES:

1. VanVlack K H, “Physical Ceramics for Engineers”, Addison Wesley, 1964.
2. Kingery, W D, “Introduction to Ceramics”, John Wiley, USA, 1960.
3. Nobuka `Ichinose, ed. “Introduction to Fine Ceramics”, John Wiley & Sons, USA, 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

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– 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:

- Use of different material to design composites
- Use of different techniques to process different types of composites and know the limitations of each process
- Use of Mathematical techniques to predict the macroscopic properties of different Laminates

TEXTBOOKS:

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

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ML8603 NON DESTRUCTIVE EVALUATION OF MATERIALS 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. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, 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 methods, applications.

Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement , Applications, advantages, Limitations, Interpretation/Evaluation.

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

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A-Scan, B-Scan, C-Scan. Phased Array Ultrasound, Time of Flight Diffraction.
Acoustic Emission Technique –Principle, AE parameters, Applications.

UNIT V RADIOGRAPHY (RT) 10

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography- Gamma ray Radiography, Safety in X- ray and gamma ray radiography.

TOTAL: 45 PERIODS

OUTCOMES:

- Identify suitable Non destructive technique to inspect industrial component
- Ability to use the different technique and know its applications and limitations

TEXT BOOKS:

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

REFERENCES:

1. ASM Metals Handbook,”Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17
2. Paul E Mix, “Introduction to nondestructive testing: a training guide”, Wiley, 2nd edition New Jersey, 2005
3. Charles, J. Hellier,“ Handbook of nondestructive evaluation”, McGraw Hill, New York 2001.
4. 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.

HS8561	EMPLOYABILITY SkILLS (LAB / PRACTICAL COURSE)	L T P C 0 0 2 1

(Common to all branches of Fifth or Sixth Semester B.E / B.Tech programmes)

OBJECTIVES

- To enhance the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills
- To help them improve their soft skills, including report writing, necessary for the workplace situations

1. Making presentations – introducing oneself – introducing a topic – answering questions – individual presentation practice
2. Creating effective PPTs – presenting the visuals effectively
3. Using appropriate body language in professional contexts – gestures, facial expressions, etc.
4. Preparing job applications - writing covering letter and résumé
5. Applying for jobs online - email etiquette
6. Participating in group discussions – understanding group dynamics - brainstorming the topic
7. Training in soft skills - persuasive skills – People skills - questioning and clarifying

skills – mock GD

8. Writing Project proposals – collecting, analyzing and interpreting data / drafting the final report
9. Attending job interviews – answering questions confidently
10. Interview etiquette – dress code – body language – mock interview

TOTAL: 30 PERIODS

OUTCOME

- The students will have enough confidence to present themselves well using proper oral and written communication skills to any interview (or) discussion (or) presentation.

REFERENCE BOOkS:

1. Dhanavel, S.P. 2010. English and Soft Skills. Hyderabad: Orient BlackSwan Ltd.
2. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
3. D'Abreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

EXTENSIVE READERS

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 1989.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES

1. www.humanresources.about.com
2. www.careerride.com

ML8611 COMPOSITE MATERIALS LABORATORY L T P C
0 0 3 2

OBJECTIVE:

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

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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: 45 PERIODS

OUTCOMES:

- The course will enable the student to learn the different fabrication processes of different composite materials and the mechanical characterization of these materials..

ML8612	CREATIVE AND INNOVATIVE PROJECT	L T P C
		0 0 3 2

OBJECTIVE

This laboratory course is train students to scientifically investigate of problem in the area of materials engineering, collect literature, hypothesize a solution, plan and execute activities of project with creativeness and innovation involving material processing, testing and characterization

The goal of this course is to help students to identify innovative projects that promotes and inhibit creativity to explore the variables that affect creativity and innovation. By the end of the period, students should be familiar with current thinking in their field, and able to apply the concepts to relevant research problems or practical applications.

The goal of this course is to drive them to learn concepts, models, frameworks, and tools that engineering graduates' need in a world where creativity and innovation is fast becoming a pre-condition for competitive advantage.

Each student will choose a nagging workplace problem or socially relavant problems that have been difficult for them to "solve." At the end of the semester, each or group of students have to submit a report for evaluation.

TOTAL: 45 PERIODS

OUTCOME

Student will know to define a problem, survey literature, systematic approach of planning and execution of activities as an individual or as a group in attempting a solution for a problem in materials engineering.

ML8613 MATERIALS CHARACTERISATION LABORATORY L T P C
0 0 3 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. Determination of precision determination of lattice parameters using an x-ray diffractometer pattern
2. Identification of an unknown structure with the use of database.
3. Fractography analysis using Scanning electron microscopy (SEM)
4. Chemical Analysis using SEM -Energy Dispersive Spectroscopy (EDS).
5. Line scan Analysis using SEM -Energy Dispersive Spectroscopy (EDS).
6. Elemental mapping using SEM-EDS
7. Quantitative image analysis of grain size, grain size distribution, and twin fraction using image analyzer.
   a) Phase fraction and grain size determination
   b) Nodularity and nodule count
8. Study of Wulff net diagram, Stereographic projection & Pole Figures
9. Indexing of SAED (Selected Area Electron Diffraction) patterns of Transmission electron microscopy (TEM)
10. Determination of flaw using Ultrasonic Flaw Detector(UFD)
11. Determination of Young's Modulus of a material using UFD.
12. Determination of index point of angle probe of UFD using Calibration Block.

TOTAL: 45 PERIODS

OUTCOME

- Student will be familiarised to various instruments for characterisation, specific sample preparation, data interpretation, analysis and presentation like XRD, SEM, etc.

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ML8701 CORROSION AND ITS PROTECTION METHODS 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 quation; passivity, electrochemical behaviour of active/passive metals, Flade potential, theories of passivity, Effect of oxidising 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.

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, 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 control the factors affects the metal corrosion.
- Ability to measure the corrosion rate.
- Ability to prevent corrosion by coatings and inhibitors, etc.

TEXTBOOKS:

1. Fontana and Greene. “Corrosion Engineering”. McGraw Hill Book Co. New York. USA 1986.
2. Raj Narayan. “An Introduction to Metallic Corrosion and its prevention”, Oxford & 1BH,

New Delhi,1983.

REFERENCES:

1. Kenneth G Budinski. “Surface Engineering for Wear Resistance”. Prentice Hall Inc.. Engelwood Cliff., New Jersey. USA 1988
2. Denny A. Jones,”Principles and Prevention of Corrosion” 2nd Edition, Prentice Hall of India,1996.
3. Uhlig. H.H. “Corrosion and Corrosion Control”. John Wiley & Sons. New York. USA. 1985.
4. ASM Metals Handbook. Vol.5. “Surface Engineering”. ASM Metals Park. Ohio. USA. 1994.
5. ASM Metals Handbook. Vol.l3,”Corrosion”. ASM Metals Park. Ohio. USA. 1994

ML8702 METAL JOINING PROCESSES AND METALLURGY L T P C
3 0 0 3

OBJECTIVE:

Metal joining is one of the most important fabrication processes used in the industry and requires both theoretical understanding of the process used and the allied welding metallurgy in order to make a successful weld, the content of the syllabus addresses to the above need.

UNIT I FUNDAMENTALS OF METAL JOINING 10

Welding - Principle of Gas Welding- Equipment-Technique- Principle of Arc –Arc Welding -Electrode types and classification- Gas Tungsten Arc Welding-Gas Metal Arc Welding-Submerged arc Welding-Atomic Hydrogen welding-plasma Arc Welding-Thermit Welding-Electro Slag Welding-Laser Beam Welding, Electron Beam Welding, magnetic pulse Welding-Principle - Resistance Welding - Spot Welding - Projection Welding - Upset Welding - Flash Welding - Forge Welding - Friction Welding, Friction stir welding - Diffusion Bonding - Explosion Welding, Soldering and Brazing-Adhesive Bonding.

UNIT II 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 III PHYSICAL METALLURGY OF WELDING 9

Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, 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 IV WELDING OF ALLOY STEELS AND NON-FERROUS METALS 9

Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions.

UNIT V DEFECTS, WELDABILITY AND STANDARDS 8

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, weldability and testing of weldments.

Introduction to International Standards and Codes

TOTAL: 45 PERIODS

OUTCOME

- The course will enable the student various welding processes used in the industry and solidification process involved in welding and its metallurgy to make a successful weld.

TEXTBOOKS:

1. R. S.Parmar, “Welding Engineering and Technology” 2nd edition M/s. Khanna Publishers 2010.
2. Baldev Raj,Shankar V,Bhaduri A K“.Welding Technology for Engineers” Narosa Publications 2009.

REFERENCES:

1. Saferian. D., “The Metallurgy of Welding”. Chapman and Hall, UK, 1985.
2. “AWS Welding Hand book”, 9th edition, Vol-1,“Welding Science and Technology”, 2001.
3. Sindo Kuo, “Welding Metallurgy”, John Wiley & Sons, 2003
4. Henry Granjon, “Fundamentals of Welding Metallurgy”, Abington Pub, 1991
5. Robert W. Messler, “Principles of Welding: Processes, Physics, Chemistry, and Metallurgy”, Wiley, 1999.
6. Linnert, G. E., “Welding Metallurgy”. Vol. 1 and 2. 4th edition. A W S. USA, 1994.
7. Lancaster, J. F. “Metallurgy of Welding”, 4th Londre: George Allen & Unwin.1987.

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ML8703 **NONFERROUS 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 **10**

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 **8**

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

OUTCOME

- The course will enable a student to understand the production of an alloy, correlate structure - property relations of nonferrous alloys with special emphasis on engineering applications.

TEXT BOOKS:

Attested

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

REFERENCES:

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

ML8711 INDUSTRIAL/ FIELD TRAINING L T P C
0 0 3 2

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 recognised industrial establishments. At the end of the training they have to submit a report with following information:

1. Profile of the Industry
2. Product range
3. Organisation structure
4. Plant layout
5. Processes/Machines/Equipment/devices
6. Personnel welfare schemes
7. Details of the training undergo
8. Projects undertaken during the training, if any
9. Learning points.

End Semester examination will be a Viva-Voce Examination.

TOTAL : 45 PERIODS

OUTCOMES

Attested

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

ML8712 SURFACE ENGINEERING LABORATORY L T P C
0 0 3 2

OBJECTIVE:

This laboratory course offers hands on experience on some surface modification technologies, corrosion and wears studies.

LIST OF EXPERIMENTS

1. Estimation of corrosion rate of mild steel by weight loss method and determination of inhibitor efficiency in acid and neutral media
2. Electroplating of Cu and Ni
3. Electroless nickel coating
4. Oxalic acid etch test for intergranular corrosion (Streicher test)
5. Evaluation of corrosion characteristics by potentiostatic /galvanostatic polarisation techniques - Study of passivation characteristics of MS and SS steels in acid media
6. Evaluation of corrosion characteristics by potentiostatic/galvanostatic polarisation techniques - Determination of pitting potential of various steels
7. Evaluation of corrosion characteristics by potentiostatic /galvanostatic polarisation techniques – Potentiostatic investigation of the effectiveness of inhibitors
8. Determination of wear, wear rate and wear characteristics pin on disc wear testing

TOTAL: 45 PERIODS

OUTCOME

- Student will be able to carry out surface modifications, evaluate their corrosion and wear characteristics by interpretation of results.

ML8811 PROJECT WORK L T P C
0 0 12 6

OBJECTIVE:

In the project work the students demonstrate their ability to apply knowledge studied during the course. Students show their ability to collect information from literature, design, perform and interpret experiments. The successful project work is documented in a formal project report and technical presentation.

A project topic must be selected either from published lists or the students themselves may

propose suitable topics in consultation with their guides. The aim of the project work is to deepen comprehension of the principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or design problem. The problem may be selected in areas of material synthesis or processing, material characterization, material joining, metal forming or casting or mechanical behaviour of materials or material testing and analysis.

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 jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

OUTCOMES:

- 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 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.

TEXTBOOKS:

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

REFERENCES:

1. Duerig,T. W., Melton, K. N, Stockel, D. and Wayman, C.M., “Engineering aspects of Shapememory Alloys”, Butterworth – Heinemann, 1990.
2. Rogers, C. A., Smart Materials, “Structures and Mathematical issues”, Technomic Publishing Co., U.S.A, 1989.
3. Mohsen Shahinpoor and Hans-Jo¨rg Schneider “Intelligent Materials”, RSC

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Publishing,2008

4. Mel Schwartz (Ed), Encyclopaedia of Smart Materials" Volume –I and II, John Wiley & Sons, Inc.2002
5. Buddy D. Ratner (Editor), Allan S. Hoffman (Editor), Frederick J. Schoen (Editor), Jack E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", Academic Press,2nd edition, 2004

ML8002 CASTING PROCESSES L T P C
3 0 0 3

OBJECTIVE:

Metal casting is one of the important manufacturing process used for manufacturing components, the content of the syllabus focuses on imparting knowledge on casting practices of Alloy steels, Magnesium, Aluminium, Zinc and Copper alloys.

UNIT I MAGNESIUM ALLOYS 8

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 10

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

UNIT III ALLOY STEELS 10

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

UNIT IV ZINC ALLOYS 8

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

TEXTBOOKS:

1. Jain, P. L., “Principles of Foundry Technology”, 4 th edition Tata McGraw Hill, 2008.
2. Heine, R. W, Loper, C. R. and Rosenthal, “Principles of Metal Casting”, McGraw Hill, New Delhi, 2010.

REFERENCES:

1. A.K. Chakrabarti “Casting Technology and Cast Alloys” Prentice Hall of India Limited 2005
2. ASM Hand Book Vol. 5 Casting, ASM International, 1998.
3. Ramana Rao, T. V., “Metal Casting Principles and Practice”, 1st edition, New Age International, 1996.

ML8003 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 SOLUTIONS OF EQUATIONS AND INTERPOLATION 9

Application for the fitting and interpolation of experimental data in Materials Science
Roots of equations – Methods of bisection and false position – Newton-Raphson method – Simultaneous equations – Gauss elimination – Gauss Jordan method - Newton’s and Langrange’s interpolation methods.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS 9

Applications in diffusion and mass transport in materials.

Type of equations – Elliptic equations – Laplace’s equation – Hyperbolic equations – Wave equations – The Lax method – Eulerian and Lagrangian methods - Parabolic Equations – Diffusion – The Dufort-Frankel Method – Conservative methods – The Equation of continuity – The Diffusion equations.

UNIT III MONTE CARLO METHODS AND SIMULATION 9

Monte Carlo Method for simulating nucleation and growth of grains in materials.
Monte Carlo – Random Number Generators – Monte-Carlo Integration – The Metropolis Algorithm – Thermodynamic Averages – Quantum Monte-Carlo – Molecular Dynamics – General Principles.

UNIT IV MATRIX ALGEBRA 9

Study of anisotropy in materials.
Introduction – types of matrix– simple matrix problems – elliptic equations – Poisson’s equation – systems of equations and matrix inversion – Exact Methods – Iterative Methods - The Jacobi

Method – The Gauss-Seidel Method – Matrix Eigen value Problems – Schrödinger's equation – Full and Partial Diagonalisation - Sturm Sequence.

UNIT V SELECTED APPLICATIONS IN MATERIALS SCIENCE **9**

Modeling and property prediction.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to use computational techniques the Materials Engineering
- Use of mathematical equation to predict the properties of materials

TEXTBOOKS:

1. Venkatraman, M. K., "Numerical Methods in Science and Engineering", National Publishing Company, Madras, 1996.
2. Sastry, S. S.," Introductory Methods of Numerical Analysis", Prentice Hall of India, New Delhi, 1992.

REFERENCES:

1. Samuel S M Wong," Computational Methods in Physics and Engineering", 2nd Edition
2. Wilkinson J H," The Algebraic Eigenvalue Problem", Clarendon Press Oxford, 1964.
3. Chandra. S.,"Computer Applications in Physics: with Fortran, Basic and C", Narosa Publications 2nd edition, 2006
4. Brenner, D. W.," Computer Applications in Materials Science and Engineering", John Wiley & Sons, 2007
5. Julian, Maureen M., "Foundations of crystallography with computer applications", CRC, 1st edition, 2008
6. Ghosh Dastidar, P. S., "Computer Simulation of Flow and Heat Transfer", Tata McGraw Hill, New Delhi, 1998

ML8004 CREEP AND FATIGUE BEHAVIOUR OF MATERIALS **L T P C 3 0 0 3**

OBJECTIVE:

The useful life of components is often limited by the fracture, fatigue and creep properties of the materials used. The students study the fundamental processes leading to failure of technical components.

UNIT I INTRODUCTION **9**

Strength of perfect crystal - Lattice resistance to dislocation movement – Elastic properties of dislocation – Dislocation multiplication – Slip and twinning in crystalline solid.

UNIT II HIGH – TEMPERATURE DEFORMATION RESPONSE **9**

Creep Of Solids – Temperature stress – Strain rate relation- Deformation mechanism –Super plasticity deformation mechanism maps – Extrapolation procedure for creep rupture data –

materials for elevated temperature rules.

UNIT III CYCLIC STRESS AND STRAIN FATIGUE **9**

Macrofractrography fatigue failures - cyclic stress and strain controlled fatigue - Fatigue life estimation for notched components – Crack initiation mechanisms.

UNIT IV FATIGUE CRACk PROPAGATION **9**

Stress and crack lengths correlations with FCP – Fracture modes in Fatigue – Microscopic fracture mechanisms – Crack growth behavior at ∆k extremes – Influences – Micro structural aspects of FCP in metal alloys.

UNIT V ANALYSIS OF ENGINEERING FAILURES **9**

Typical defects – Microscopic surface examination – metallographic and fractographic examination – Component failure analysis – Fracture surface preservation – Cleaning and replication techniques and image interpretation.

TOTAL: 45 PERIODS

OUTCOMES:

- Identify the fracture due to creep and fatigue
- Use of suitable mathematical equation to predict ability the crack growth rate
- Ability to perform failure analysis

TEXTBOOKS:

1. Richard. W. Hertzberg,“ Deformation and Fracture Mechanism of Engineering Materials”, John Willey and Sons, 4th edition, 1996.
2. Anderson, T. L.,“ Fracture Mechanics: Fundamentals and Applications”, CRC Press, 2nd edition, 1995.

REFERENCES:

1. Courtney, T. H.,“ Mechanical Behaviour of Materials”, McGraw-Hill, 1990
2. Jones, D. R. H,“ Engineering Materials 3, Materials Failure Analysis- Case Studies and Design Implications”, Pergamon, 1993.
3. Hull & Bacon “Introduction to Dislocations”, 3rd ed., Pergamon Press, 1984.
4. Frost & Ashby, “Deformation - Mechanism Maps”, 1st ed., Pergamon Press, 1982.
5. Suresh, S.,“ Fatigue of Materials”, Cambridge University Press, 2 nd edition, 1998.
6. Cadek, J.,“ Creep in Metallic Materials”, Elsevier, 1988.
7. Ashok Saxena,“ Nonlinear Fracture Mechanics for Engineers”, CRC Press, 1998.

ML8005 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.LindeHampsonCycle, Precooled LindeHampson 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

TEXTBOOK:

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

REFERENCES:

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

ML8006 ELECTRON MICROSCOPY AND DIFFRACTION **L T P C**

ANALYSIS OF MATERIALS 3 0 0 3

OBJECTIVE:

The characterization of sub-micron to nano-structured materials to reveal the structure-property-correlation involves electron microscopy and thereby diffraction analysis of materials. The course provides an in-depth understanding of the crystal structure and symmetry elements, diffraction theory and analysis as well as spectroscopy and electron microscopy.

UNIT I BASICS OF CRYSTALLOGRAPHY AND ELECTRON OPTICS 7

Introduction – Electron Optics – microscopy and the concept of resolution – interaction of electrons with matter – depth of field and depth of focus, crystallography – symmetry elements – symmetry operations, point groups, space groups, indexing planes, indexing lattice directions – plane normals – zones and the zone law, stereographic projection – Wulff Net

UNIT II ELECTRON DIFFRACTION THEORY 9

Basics of electron diffraction – scattering by an individual atom, scattering by a crystal – Bragg law – Laue conditions, reciprocal lattice and diffraction by a single crystal – Ewald sphere construction, elastic scattering, inelastic scattering, Structure Factor, intensity distribution in reciprocal space - standard spot patterns

UNIT III TRANSMISSION ELECTRON MICROSCOPES 9

Working principle of TEM – important aspects of microscope operation and alignment – aberration correction – resolution, formation of diffraction patterns and images – SAED – bright and dark field images – Centered dark field images - weak beam images – sample preparation, advanced TEMs – HRTEM

UNIT IV DIFFRACTION ANALYSIS 10

Types of diffraction patterns – ring pattern – spot pattern – Kikuchi pattern, indexing diffraction patterns – spots/ kikuchi lines produced by planes in one zone – spots/ kikuchi lines arising from different zones – imperfect patterns – kikuchi maps – Electron Back Scattered Diffraction Pattern (EBSD), standard spot patterns, uniqueness in indexing diffraction patterns - 180° ambiguity, usage of electron diffraction patterns – orientation relationship determination – second phase identification – defect analysis, other diffraction spots – extra spots, satellite spots and streaks – identification of materials

UNIT V SCANNING ELECTRON MICROSCOPES 10

Working principles of SEM, depth of field (focus), interaction volume, secondary electrons, backscattered electrons, Spectroscopy – Energy Dispersive X-ray spectroscopy – wavelength dispersive X-ray spectroscopy – Electron energy loss spectroscopy, microscope operation – imaging – sample preparation, advanced SEMs – Scanning Transmission Electron Microscope (STEM)

TOTAL: 45 PERIODS

OUTCOME:

- The student will able to interpret characterization results of diffraction pattern and images of electron microscopy, so as to identify phase, symmetry, crystal

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structure, orientation, defects, etc and elemental composition bulk from X-ray spectroscopy and of surface from electron energy loss spectroscopy.

TEXTBOOKS:

1. Peter J. Goodhew, John Humphreys, Richard Beanland, "Electron Microscopy and Analysis", 3rd Edition, Taylor and Fransis, II New Fetter Lane, London, 2001.
2. David B. Williams and C. Barry Carter, "Transmission Electron Microscopy: A Text Book for Materials Science", Publisher: Springer, USA, 2009.

REFERENCES:

1. J. W. Edington, "Electron Diffraction in the Electron Microscope", N. V. Philips' Gloeilampenfabrieken, Eindhoven, 1975.
2. Joseph Goldstein, Dale Newbury, David Joy, et al., "Scanning Electron Microscopy and X-ray Microanalysis", Kluwer Academic / Plenum Publishers, New York, 2003.
3. Marc De Graef, "Introduction to Conventional Transmission Electron Microscopy", Cambridge University Press, UK, 2003.

ML8007 ENERGY STORING DEVICES AND FUEL CELLS L T P C
3 0 0 3

OBJECTIVE:

- 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 BATTERY CHARACTERISTICS 9

Voltage, current, capacity, electricity storage density, power, discharge rate, cycle life, energy efficiency, shelf life.

Primary batteries: The chemistry, fabrication, performance aspects, packing and rating of zinc-carbon, magnesium, alkaline, manganous dioxide, mercuric oxide, silver oxide batteries, zinc/air and lithium button cells- solid electrolyte cells.

UNIT II SECONDARY BATTERIES 9

The chemistry, fabrication and performance aspects and rating of lead acid and valve regulated (sealed) lead acid, nickel-cadmium, nickel-zinc, lithium and lithium ion batteries - Rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, thermal batteries.

Batteries for electric vehicles: Metal/air, zinc-bromine, sodium-beta alumina and lithium/iron sulphide batteries. (outline only) Photogalvanic cells. Battery specifications for cars, heart pacemakers, computer standby supplies etc.

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UNIT III FUEL CELLS **9**

Introduction – relevance, importance and classification of fuel cells. Background theory - thermodynamic aspects of electrochemistry-energy conversion and its efficiency – factors affecting the efficiency, electrode kinetics of electrochemical energy conversion.

UNIT IV TYPES OF FUEL CELLS **9**

Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells. Proton Exchange Membrane fuel cells - basic aspects – working and high temperature operation – recent development in technology.

UNIT V HYDROGEN AS FUEL, SOLAR CELL AND ENVIRONMENT **9**

Sources of hydrogen and preparation – clean up and storage – use as fuel in cells.
Energy conversion devices, photovoltaic and photo electrochemical cells – photo biochemical conversion cell.
Future prospects-renewable energy and efficiency of renewable fuels – economy of hydrogen energy – life cycle assessment of fuel cell systems.

TOTAL: 45 PERIODS

OUTCOME:

- Course enable student to understand latest energy storage and fuel cell technology and designing principle related to energy efficiency.

TEXT BOOKS:

1. Aulice Scibioh M.and Viswanathan B, “Fuel Cells – principles and applications’, University Press (India), 2006
2. Pletcher D and Walsh C,“Industrial Electrochemistry”, Blackie Academic and Professional, 1993.

REFERENCES:

1. Christopher M A Brett, “Electrochemistry – Principles, Methods and Applications”, Oxford University, 2004.
2. Newman J S and Thomas -Alyea K.E. “Electrochemical systems” (3rd ed) Wiley, Hoboken, NJ 2004.
4. Hoogers G (Ed), “Fuel cell handbook” CRC, Boca Raton, FL 2003
5. Lindon David, “Handbook of Batteries”, McGraw Hill, 2002
6. Dell, Ronald M Rand, David A J, “Understanding Batteries”, Royal Society of Chemistry, 2001
7. Barbir F “PEM fuel cells: theory and practice” Elsevier, Burlington, MA 2005.

ML8008 FRACTURE MECHANICS AND FAILURE ANALYSIS **L T P C**
3 0 0 3

OBJECTIVES:

Attested

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- 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. Evalds H L and RJH Warnhil, ”Fracture Mechanics”, Edward Arnold Ltd, Baltimore, 1984.
2. 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.
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.

ML8009 FUELS, FURNACES AND REFRACTORIES L T P C
3 0 0 3

OBJECTIVE:

Many industries require process heat in the production and treatment of materials. This course teaches fundamentals and applications of fuels, furnaces sand refractories.

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 9

Heat resistant materials in steel making and non ferrous production plants. Applications in the power, energy conversion, petroleum and chemical industries.

UNIT V ADVANCED ISSUES 9

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.

Attested

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TEXTBOOKS:

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, 1987.

REFERENCES:

1. Yeshvant V. Deshmukh, "Industrial Heating: Principles, Techniques, Materials, Applications, and Design", CRC Press, 2005
2. Gilchrist, J. D., "Fuels, Furnaces and Refractories", Pergamon Press, 1977.

ML8010 INDUSTRIAL TRIBOLOGY L T P C
3 0 0 3

OBJECTIVES:

- 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.

TEXTBOOK:

1. A. Harnoy. "Bearing Design in Machinery "Marcel Dekker Inc, NewYork, 2003.

REFERENCES:

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

ML8011 INTRODUCTION TO TRANSPORT PHENOMENA L T P C
3 0 0 3

OBJECTIVE:

The subject introduce the students about the fundamental fluid mechanics, flow and energy transfer, in order understand and analysis the transport phenomena occurs in casting, welding, energy storing /transferring devices, mineral processing, chemical processing etc.

UNIT I FLUID MECHANICS 9

Properties of fluids such as density, viscosity and specific weight. Fluid statics - Pressure at a point - Pressure variations in horizontal and vertical directions - Concept of gauge and absolute pressure. Use of manometer for pressure measurements. Introduction to Hydrostatic Forces.

Energy Balance in Fluid Flow: Types of flow - continuity equation - Application to one dimensional problems. Derivation of Bernoulli's equation and Euler's equation - Examples illustrating the use of energy equation in metallurgical processes.

UNIT II INTERNAL AND EXTERNAL FLOW 8

Classification of flow - Reynolds number - Laminar flow between parallel plates and circular pipes - Simple problems.

Pressure in Fluid Flow: Head loss due to friction -Darcy - Weisbach equation - flow through pipes - use of Moody diagram - Minor losses - Simple problems.

UNIT III CONDUCTION HEAT TRANSFER 10

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Steady state heat conduction - simple examples. Transient heat conduction - Systems with negligible internal resistance - Lumped heat analysis - Response time of a temperature measuring instrument - System with negligible surface resistance- heat flow in an infinitely thin plate (Semi infinite body) - System with finite surface and internal resistance - Chart solutions of transient heat conduction problems – Examples on Heat Treatment

UNIT IV CONVECTIVE HEAT TRANSFER 8

Forced and free convention - Boundary layer concept -velocity and thermal boundary layers (no derivation) - Simple problems - Flow over flat plate - laminar and turbulent boundary layers (no derivation) - Simple problems – Boundary layer development in a circular duct (no derivation) - Flow over cylinders and spheres-Simple problem- applications in metallurgical processes.

UNIT V RADIATION HEAT TRANSFER 10

Nature of thermal radiation, Concept of Black body, Emissive power – Gray body - Shape factor - Simple problems on Radiation heat transfer between surfaces. Introduction to Gas radiation.

Mass Transfer: Diffusion mass transfer. Simple problems using Fick's law of diffusion. Introduction to convective mass transfer-Introduction to computational fluid dynamics-software.

TOTAL: 45 PERIODS

OUTCOME:

- This course enables the students apply the knowledge of fluid mechanics, mass transport with respect to temperature and pressure as specific to mineral processing, liquid metal – solidification, etc. of materials technology.

TEXT BOOkS:

1. Kothandaraman C.P. and Rudramoorthy, R., "Basic Fluid Mechanics", New Age International Publishers, Chennai 1998,
2. Sachdeva, R C," Fundamentals of Engineering Heat and Mass Transfer", New Age International Publishers, New Delhi, 1996.

REFERENCES:

1. Kothandaraman C P , "Fundamentals of heat and Mass Transfer", second edition, New Age International Publishers, Chennai, 1997.
2. Byron Bird R, W E Shawart, "Transport Phenomena", John-Wiley & Sons Inc, 1994.
3. Robert, W Fox, "Introduction to Fluid Mechanics", John Wiley & Sons, New York, USA, 1994.
4. Irving H Shames," Mechanics of Fluids", third edition, McGraw Hill Publishing Co., New York, 1992.

ML8012 **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 **10**

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 **8**

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.

TEXTBOOKS:

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.

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REFERENCES:

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

ML8013 MAKING AND METALLURGY OF STAINLESS STEELS L T P C
3 0 0 3

OBJECTIVE:

Products made out of various types of Stainless steels find extensive applications both in domestic and Industrial applications. The aim of this subject is to provide a comprehensive knowledge on various aspects of Stainless steel making, metallurgy, Properties and its applications.

UNIT I HISTORY AND EVOLUTION OF STAINLESS STEEL 8

Essential elements, evolution, development of alloys, selection of Stainless steels, Recent processing enhancements.

UNIT II CLASSIFICATION OF STAINLESS STEELS 10

Wrought and Cast Stainless steels – Ferritic, Martensitic, Austenitic,Cr-Ni-Mo Stainless steels, Precipitation Hardened, Duplex, Heat Resistant, Abrasive and Wear resistant steels-Composition, Metallurgy, Properties, Phase Diagrams, Fretting and Galling, Welding and Weldability of Stainless steels.

UNIT III MELTING AND SECONDARY REFINING OF STAINLESS STEELS 9

Raw Materials selection, Melting Furnaces (EAF, EIF), melt treatment, secondary refining – AOD, VOD, IOC converters processing, advantages and limitations.

UNIT IV CORROSION BEHAVIOUR OF STAINLESS STEELS 9

Atmospheric, aqueous, stress corrosion, cracking and Hydrogen Embrittlement, High Temperature corrosion, Corrosion of Cast stainless steels, PREN Index, Corrosion rate estimations- ASTM Practices.

UNIT V APPLICATIONS OF STAINLESS STEELS 9

Architecture and construction, Automotive and Marine systems, Petroleum, Chemical, Pulp and Paper Industries applications.

TOTAL: 45 PERIODS

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OUTCOME:

- The student will understand the production methodology of stainless steel making and also he gains knowledge on the metallurgy of stainless steel making**.**

TEXT BOOKS:

1. Jonathan Beddoes, J. Gordon Parr, "Introduction to Stainless Steels", Jonathan Beddoes, J. Gordon Parr ASM International
2. Joseph R. Davis , "STAINLESS STEELS", ASM International, 3rd print,--1999
3. John C. Lippold, Damien J. Kotecki, "Welding Metallurgy and Weldabiiity of Stainless steels", Wiley and Sons, Edition 2005

REFERENCES :

1. R.A. Lula, James Gordon Parr , "Stainless steels", American Society for Metals, 1996.
2. Joseph R.Davis, "Alloy Digest Source Book: Stainless Steels", ASM International, 2000.
3. Source book on Stainless steels, American Society for Metals, 1976.
4. Donald Peckner,Irving Melvis Bernstein , "Hand Book of Stainless steels", McGraw Hill, 1977.
5. Michael F. McGuire , "Stainless steels for Design Engineers", ASM International, 2008

ML8014 METALLURGY OF TOOL MATERIALS L T P C
3 0 0 3

OBJECTIVE:

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

UNIT I CLASSIFICATION AND MANUFACTURE OF TOOL STEELS 8

Classification – AISI system, selection of tool steels from the point of view of mechanical properties, Effect of alloying elements such as W, Mo, Ni, V, Ti etc., in Tool steels, Production techniques –problems in melting – powder metallurgy route, Refining methods like VAR, ESR – forming of tool steels.

UNIT II HEAT TREATMENT OF TOOL STEELS AND DEFECTS 13

HEAT TREATMENT AND METALLURGY OF W, S, O, A & D TYPE TOOL STEELS Water hardening tool steels, shock resistance tool steels, cold work tool steels-oil hardening, medium alloy and high carbon-high Cr(O,A&D types): Constitution, classification of principal types, heat treatment process, hardenability, distortion characteristics, properties and application.

HEAT TREATMENT AND METALLURGY OF H, T, M, SPECIAL PURPOSE TOOL STEELS Hot work tool steels, high speed tool steels, maraging tool steels, special purpose tool steels: constitution, classification of principal types, heat treatment process, specific requirements and applications.

UNIT III PROPERTIES, TESTING AND FAILURE OF TOOL STEELS 7

Mechanical properties of Tool steels with respect to applications – Elevated temperature properties – Microstructures –Carbide distribution –Coating thickness, micro hardness – Adhesion and Scratch resistance. Tool failures – material heat treatment , manufacturing processes and Operational factors.

UNIT IV ADVANCED TOOL MATERIALS 10

intered Tungsten Carbide tools – ISO classification, Uses of P, M, K,H,W, S, O, A ,T grades Cermet – ceramics, mixed and reinforced grades –WC, Al2O3, SiC , CBN, PCD, TaC, TiC, Solid Carbide tools – Manufacturing techniques, heat treatment and properties, Stellites, Cemented carbides, ceramic tools, Special purpose tool steels.

UNIT V SURFACE TREATMENTS AND COATINGS 7

Sulphidizing of tool steels – TiN coating by PVD, coating of Carbide tools –Mono and multi layer Coatings of TiC, TiN, Alumina and DLC by PVD and CVD processes.

TOTAL: 45 PERIODS

OUTCOME:

- Student will understand the type and process undergone by a cutting tool by their specification, technology like heat treatment and coating techniques for better machining characteristics.

TEXT BOOK:

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

REFERENCES:

1. Robert Wilson, "Metallurgy and Heat treatment of Tool Steels, McGraw Hill New York, 1975
2. Roberts, Haymaker and Johnson – "Tool Steels" 3rd edition, ASM 1962
3. Joseph R. Davies – "Tool Materials", ASM International, 1995

ML8015 MICRO MACHINING AND FABRICATION L T P C
3 0 0 3

OBJECTIVE:

To introduce the various types of micromachining processes and their Applications.

UNIT I INTRODUCTION 9

Introduction to micromachining process – Classification of micromachining and nanomachining processes – Molecular dynamics, principle of molecular dynamics simulation- potential energy function – Boundary condition – MD simulation procedure.

UNIT II MICROFABRICATION METHODS 9

Methods of Microfabrication – Maleno deposition – Electro discharge deposition, Chemical vapour deposition physical vapour deposition – Electro Chemical spark deposition – LIGA.

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UNIT III MECHANICAL MICROMACHINING **9**

Ultrasonic machining – Abrasive jet machining – Abrasive water jet machining, water jet machining – Beam energy micromachining – Electron beam machining, electro discharge machining, ion beam machining, focused ion beam machining.

UNIT IV MICROMACHINING AND NANO FUNCTIONING wITH ABRASIVE FLOw **9**

Process- principle and description – Process Technology -Selection of machine -Effect of process parameter on performance – Mechanism of materials removal Magneto Rheological Nanofunctioning Process. Nano functioning – Smart Rheological fluids – Magneto Rheological polishing fluid – Rheological character is of MRP fluid – MRF process – MRAFF Process – MRJF process.

UNIT V HYBRID MICRO MACHINING **9**

Chemical Mechanical polishing – Electro chemical spark micro machining – Electro discharge grinding – Electrolytic in process dressing – Application.

TOTAL: 45 PERIODS

OUTCOME:

- The student will gain knowledge of material removal mechanism and technology of various types of micromachining processes and their applications.

TExT BOOk:

1. V.K.Jain – Introduction to Micromachining – Narosa Publishing house 2010.

REFERENCES:

1. Sami Franssito : Introduction to Micro fabrication – Johnwiley and sons.
2. Jain V.K. Advanced machining process, Allied Publisher, Delhi 2002.
3. Mohammed Gad-el-Hat: “The MEMS Hand book” CRC Press 2006.

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 MODELING **9**

Elastic Medium, visco-elastic constitutive equations.

UNIT III CONSTITUTIVE MODELING **9**

Plastic Medium.

9

UNIT IV SOFTWARE PACKAGES

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.

TEXTBOOKS:

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

REFERENCES:

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

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ML8017 **NANOSTRUCTURED 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. Buck 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:

- Ability to design nanostructure using Building blocks of Nanotechnology
- Ability to use OD, 1D, 2D nano building block to process bulk nano structures
- Use of difficult characterization techniques to study the Fundamental properties.

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TExT BOOkS:

1. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.
2. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd edition, 2007.

REFERENCES:

1. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, New Delhi, 2003.
2. Charles P. Poole Jr., Frank J. Ownes, 'Introduction to Nanotechnology", Wiley Interscience, 2003.
3. G. Wilde, "Nanostructured Materials', Elsevier, 2008.
4. Bamberg, D., Grundman, M. and Ledentsov, N.N., "Quantum Dot Heterostructures", Wiley, 1999.
5. G Timp (ed), "Nanotechnology", AIP press/Springer, 1999.
6. 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,

ML8018 NUCLEAR MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- To Impart knowledge about different nuclear materials and technology
- To get awareness of about nuclear waste and prevention techniques
- To know about irradiation effects in nuclear fuels.

UNIT I INTRODUCTION 8

General nuclear physics, binding energy curves, fission and fusion reactions, nuclear reactor types, Indian energy scenario, inevitability of nuclear energy in India, 3 stage nuclear power programme. Ores and benefication – Uranium and thorium ores, availability in India, solvent extraction and ore beneficiation.

UNIT II NUCLEAR FUELS FABRICATION AND CHARACTERISATION 10

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 III HANDLING OF PU AND IRRADIATION EFFECTS IN NUCLEAR FUELS 10

Health physics, radioactivity and safety aspects. Equipment and laboratory facility for Pu fuel fabrication. Irradiation behaviour and Post – Irradiation examination of Fuel. 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.

UNIT IV STRUCTURAL MATERIALS 10

Zirconium based alloys for PHWRs – Zircaloy and Zr-Nb based alloy, alloy design philosophy, hydride cracking and role of texture, pilgering and clad fabrication routes.Stainless steels for FBRs – Alloy design, irradiation behaviour of austenitic stainless steels, futuristic ferritic / martensitic and ODS ferritic stainless steels.

Ferritic steels for steam generator materials – alloy development, inherent creep strength concepts, SCC resistance. Irradiation hardening, irradiation swelling, irradiation embrittlement, irradiation induced and irradiation enhanced creep, irradiation assisted SCC.

UNIT V REPROCESSING AND WASTE MANAGEMENT MATERIAL 7

Titanium and its alloys for reprocessing, electrode materials, PUREX and THOREX repartitioning processes for recovering U, Th from spend fuel. Metallic glass and advanced alloys for waste management. Modern Nuclear Reactors and Technology.

TOTAL : 45 PERIODS

OUTCOMES:

- Familiarize students of the present and latest fuel and technology in Nuclear reactor
- Ability to discuss the Nuclear radiation and the controlling methods.
- Ability to realize the importance of nuclear waste, handling and disposal.

TExT BOOkS

1. A.R.Kaufman “Nuclear Reactor Fuel Elements, Metallurgy and Fabrication” , John Wiley, 1962
2. C.K.Gupta, “Materials in Nuclear Applications” – vol.1, CRC publications, 1989.

REFERENCES

1. Olander. D.R., “Fundamental Aspects of Nuclear Reactor Fuel Elements” –NTIS publication, 1976.
2. Frost,”Nuclear Fuel Elements: design fabrication and performance”, Pergamon Press, 1982.

ML8019 PHASE TRANSFORMATIONS L T P C
3 0 0 3

OBJECTIVE:

The students having been taught the fundamentals of thermodynamics, physical metallurgy and diffusion processes can undergo an in depth study of the various phase transformation processes that take place in metals and alloys.

UNIT I DIFFUSION MECHANISMS 9

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 TRANSFORMATIONS 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 – extension to heterogeneous nucleation – nucleation rate and growth rate – overall transformation rate, concept of activation energy – Arrhenius equation – Johnson-Mehl-Avrami equation, pearlitic transformations.

UNIT III DIFFUSIONLESS PHASE TRANSFORMATIONS 9

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 9

Precipitation reaction – 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 RECOVERY, RECRYSTALLISATION AND GRAIN GROWTH 8

Cold working and hot working, recovery – polygonisation and dislocation movements in polygonisation, recrystallisation – effect of time, temperature, strain and other variables – mechanism of nucleation and growth, grain growth – grain growth law, geometrical collisions, preferred orientation, secondary recrystallisation.

TOTAL: 45 PERIODS

OUTCOME

- Student will able apply knowledge of physical metallurgy related to phase transformation of ferrous and non ferrous alloys, to understand heat treatment, material processing condition and service conditions.

TEXT BOOKS:

1. Jena, A.K., and Chaturvedi, M., "Phase Transformations in Materials", Prentice-Hall, 1993.
2. David A. Porter, Kenneth E. Easterling, Mohamed Y. Sherif, "Phase Transformations in Metals and Alloys", CRC Press, New York, 3rd edition, 2009.

REFERENCES:

1. Romesh C. Sharma, "Phase Transformation in Materials", CBS Publishers & Distributors, New Delhi, 2002.
2. Reed Hill. R. E., "Physical Metallurgy Principles", Affiliated East West Press, New Delhi, 1992.
3. Anil Sinha, "Physical Metallurgy Handbook", McGraw-Hill Professional; 1st edition, 2002.

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ML8020 PRINCIPLES OF METAL CUTTING L T P C
3 0 0 3

OBJECTIVE:
To learn about metal cutting operations from the theoretical and practical perspective.

UNIT I CUTTING TOOL NOMENCLATURE 9
Single point tool-significance of the various angles - Machine reference system- normal toll reference system- ORS – interrelation between different tool nomenclatures - Nomenclature of drills, milling cutters and broaches

UNIT II CHIP FORMATION MECHANISM AND FORCES IN MACHINING 10
Orthogonal and oblique cutting - Mechanisms of formation of chips-types of chips -Merchant's circle diagram-Force and Velocity relationship, shear plane angle, Energy considerations in matching-Ernst Merchant's theory of shear angle relationship - Forces in turning, drilling, milling and grinding- specific cutting pressure-specific horse power- construction and principle of operation of tool dynamometers for turning, drilling and milling.

UNIT III THERMAL ASPECTS IN MACHINING, TOOL wEAR AND LIFE 10
Sources of heat generation in machining heat in PSDZ and SDZ – heat flow in cutting tools temperature measurement techniques in machining, Functions of cutting fluid - characteristics of cutting fluid-types - application of cutting fluids - Tool wear, type of tool failure - mechanisms, tool life equation- tool life analysis - machinability - chatter in machining.

UNIT IV CUTTING TOOL MATERIALS 8
Requirements of tool materials-properties of HSS - advances in tool materials- carbides and coated carbides, ceramic, cermets, CBN, Diamond, PCD - ISO-specifications for inserts and tool holders - -Need for chip breakers – types of chip breakers

UNIT V MODELING OF METAL CUTTING 8
Introduction to modeling – empirical models – mechanistic models – FEA based models – artificial intelligence based models for turning, milling and drilling

TOTAL: 45 PERIODS

OUTCOME:
- The course will enable a student to gain practical knowledge on the metal cutting operations and design of cutting tool.

TEXTBOOKS:
1. Kuppuswamy, G., "Principals of Metal Cutting", Universities Press Limited, Hyderabad, 1996.
2. Bhattacharya, "Metal Cutting Theory and Practice ", Central Book Publishers, Calcutta, 1984.

REFERENCES:
1. Edward M. Trent and Paul K. Wright "Metal Cutting" Butterworth-Heinemann; 4th edition 2000.
2. Boothroyd, G., "Fundamentals of Metal Machining and Machine Tools", McGraw-Hill

Co., 1975.

3. Sadasiavm, T.A. and Sarathy, D., “Cutting tools for productive machining” WIDIA India limited, Bangalore, 1999.
4. Milton C. Shaw,“ Metal Cutting Principles”, Oxford University Press, 2nd edition 2004.

ML8021 THIN FILM TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

The course is designed to impart the students the knowledge of surface modification technologies of deposition of thin film for different application like optical emission, abrasion resistance, dielectric, electronic applications, energy conversion, etc.

UNIT I BASICS OF THIN FILMS 9

Cosine law of emission. Emission from a point source. Mass of material condensing on the substrate. Chemical methods: Qualitative study of preparation of thin films by Electroplating, vapour phase growth and anodization. Physical methods: Vacuum evaporation -

UNIT II PREPARATION OF THIN FILMS 10

Study of thin film vacuum coating unit - Construction and uses of vapour sources-wire, sublimation, crucible and electron bombardment heated sources. Arc and Laser evaporation. Sputtering - Study of glow Discharge - Physical nature of sputtering - Sputtering yield - Experimental set up for DC sputtering, AC sputtering and RF sputtering. Nucleation and growth of thin films (qualitative study only): Four stages of film growth.

UNIT III DEPOSITION MONITORING AND CONTROL 8

Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. Thickness measurement: Multiple Beam Interferometer, Fizeau (Tolansky) technique - Fringes of equal chromatic order (FECO) method - Ellipsometry (qualitative only).

UNIT IV PROPERTIES OF THIN FILM 9

Sheet resistance - size effect - Electrical conduction in thin metallic films. Effect of Ageing and Annealing - Oxidation - gglomeration.Dielectric properties: DC conduction mechanism - Low field and high field conduction. Breakdown mechanism in dielectric films - AC conduction mechanism. Temperature dependence of conductivity.

Optical properties: Optical constants and their determination - Spectrophotometer method. Anti-reflection coatings. Interference filters. Thin film Solar Cells CuInSe2 solar cell.

UNIT V APPLICATION OF THIN FILMS 9

Thin film resistors: Materials and Design of thin film resistors (Choice of resistor and shape and area) - Trimming of thin film resistors - sheet resistance control - Individual resistor trimming. Thin film capacitors: Materials - Capacitor structures - Capacitor yield and capacitor stability. Thin film field effect transistors: Fabrication and characteristics - Thin film diodes.

TOTAL: 45 PERIODS

OUTCOME

- The student will gain knowledge on surface modification technologies of deposition of thin film for different application like optical emission, abrasion resistance, dielectric, electronic applications, energy conversion, etc.

TEXTBOOKS:

1. Goswami A, "Thin Film Fundamentals", New Age International (P) Ltd., 1996.
2. K.L. Chopra, "Thin Film Phenomena", McGraw-Hill,1983.

REFERENCES:

1. Rao V V, Ghosh, T.B., Chopra, K.L., "Vacuum Science and Technology", Allied Publications, 1998.
2. Aicha Elshabini-Riadaud Fred D Barlow III, "Thin Film Technology Hand book", Mc Graw Hill Company, 1997.
3. Maissel L.I and Glang R, "Hand Book of Thin Film Technology", McGraw Hill, 1970.
4. Anders H, "Thin Films in Optics", Focal press, 1967.
5. Schwartz B and Schwartz N, "Measurement Techniques for Thin Films", JohnWiley & Sons, 1967.
6 Guthrie A, "Vacuum Technology", John Wiley and Sons, 1963.
7. Holland L, "Vacuum Deposition of Thin Films", Chapman and Hall, 1956.
8. Heavens O S, "Thin Film Physics", Butterworths Scientific publications, 1955.

ML8071 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.

Attested

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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

TEXTBOOKS:

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

REFERENCES:

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

GE8751 ENGINEERING ETHICS AND HUMAN VALUES L T P C
3 0 0 3

OBJECTIVES :

To understand the ethical concepts that help engineers resolve moral issues in engineering and management areas and to provide an understanding of the interface between social, technological and natural environments.

UNIT I 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 – Professions and Professional – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL ExPERIMENTATION **9**

Engineering as Experimentation – Engineering as responsible Experimenters – Research Ethics – Codes of Ethics – industrial Standards – A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEERING RESPONSIBILITY FOR SAFETY **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator 's Approach to Risk – Chernobyl Case Studies and Bhopal

UNIT IV RESPONSIBILITIES AND RIGHTS **9**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – iscrimination

UNIT V HUMAN VALUES & GLOBAL ISSUES **9**

Human values- virtues and values- Morale and ethical values in work environment - Multinational Corporations – Business Ethics – Environmental Ethics – Computer Ethics – Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL: 45 PERIODS

OUTCOMES:

- 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. M. Govindarajan, S. Natarajan and V.S. Senthil Kumar, "Engineering Ethics", PHI (2010)
2. Mike Martin and Roland Schinzinger, Ethics in Engineering', McGraw Hill, New York (2005)

REFERENCES:

1. Charles E Harris Micheal S Pritchard and Micheal J Rabins, " Engineering Ethics – Concepts and cases", Thompson Learning, (2000)
2. Charles D Fleedermann, "Engineering Ethics", Prentice Hall, New Mexico, (1990).
3. John R Boattright, " Ethics and the conduct of Business", Pearson Educaion, (2003)
4. Edmund G Seebauer and Robert L Barry, " Fundamentals of Ethics for Scientist and Engineers", Oxford University Press (2001)
5. Prof. (Col) P S Bajaj and Dr.Raj Agarwal, " Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
6. David Erman and Michele S Shauf, " Computers, Ethics and Society", Oxford University Press, (2003)

MG8654 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To understand the various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Basic concepts of TQM – TQM Framework - Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II TQM PRINCIPLES **9**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & 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 & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures - BPR.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits –Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

TOTAL : 45 PERIODS

OUTCOMES:

- 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, et al., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint , 2006.

REFERENCE BOOKS:

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition , 2003.

3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”,Prentice Hall (India) Pvt. Ltd., 2006.

IE8755 DESIGN OF EXPERIMENTS L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge to design experiments to a problem situation using traditional experimental designs as well as Taguchi Methods.
- To develop skill to conduct experiments and analyze 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- 2K 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 2K Designs- blocking in replicated design- 2K Factorial Design in two blocks- Complete and partial confounding- Confounding 2K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2K 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:

- Able to apply experimental techniques to practical problems to improve quality of processes / products by optimizing the process / product parameters.

TEXT BOOKS:

1. Krishnaiah K, and Shahabudeen P, Applied Design of Experiments and Taguchi Methods, PHI Learning Private Ltd., India, 2011
2. Douglas C. Montgomery, Design and Analysis of Experiments, John Wiley & sons, 2005.

REFERENCES:

1. Phillip J. Ross, Taguchi Techniques for Quality Engineering, Tata McGraw-Hill, India, 2005
2. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., "Statistics for Experimenters: Design, Innovation, and Discovery", 2nd Edition, Wiley, 2005.

ME8010 APPLIED THERMAL ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

To apply the concepts and laws of thermodynamics for heat engines - Internal Combustion(IC)
engines, Compressor, Gas Turbines, Boilers, Refrigeration and Air Conditioning Systems.

UNIT I GAS AND VAPOUR Power CYCLES 9

Air Standard Cycles - Otto, Diesel, Dual, Brayton, Rankine – cycle Analysis and performance calculations

UNIT II INTERNAL COMBUSTION ENGINES AND ITS SYSTEMS 9

IC engine Classification, components and functions. Actual and theoretical - valve and port timing diagrams, Comparison of two stroke & four stroke engines and SI & CI engines. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines Ignition, lubrication and cooling systems. Exhaust gas analysis.

UNIT III STEAM NOZZLE AND BOILERS 9

Types of nozzles, Flow of steam through nozzles, Shapes of nozzles, Effect of friction, Critical pressure ratio, Metastable flow. Types of boilers, Thermal calculations, Heat balance, Mountings and Accessories,

UNIT IV GAS TURBINES AND STEAM TURBINES 9

Open and closed Gas turbine cycle analysis - methods of cycle improvement. Regenerative, intercooled, reheated cycles and their combinations.
Types, Impulse and reaction principles, Compoundings, Velocity diagrams for impulse and reaction blades, Work done on turbine blades and efficiency of components, Cogeneration Principles, Cycle Analysis.

Attested

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UNIT V COMPRESSION , REFRIGERATION AND AIR – CONDITIONING 9

Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling – work of multistage air compressor.

Vapour compression Refrigeration cycle, Superheat, Sub cooling, Performance calculations, Working principle of vapour absorption system, Air cycle refrigeration, Psychrometry and Psychrometric properties, Psychrometric chart, Instrumentation, Cooling load calculations and circulating systems, Air conditioning systems.

TOTAL: 45 PERIODS

OUTCOME

- Students will have overview of applied thermal engineering which will help to understand materials development and working conditions related to thermal shock, hot corrosion, etc.

TEXT BOOKS:

1. Rajput, R.K., Thermal Engineering, 8th Edition, Laxmi Publications, 2010
2. Ballaney, P.L., "Thermal Engineering" , Khanna Publishers, 24th Edition, 2003.

REFERENCES:

1. Rathore, M.M, Thermal Engineering, McGraw Hill, 2010.
2. Rudramoorthy, R., Thermal Engineering, 4th Edition, Tata McGraw Hill, New Delhi, 2006.
3. Domkundwar, Kothandaraman, and Domkundwar, A Course in Thermal Engineering, Dhanpat Raj & Sons, Fifth edition, 2002. Sarkar B K, Thermal Engineering, McGraw Hill, 2001
5. Zucro,N.J., Principles of jet propulsion and gas turbines, John Wiley, New York, 1970.
6. Ganesan.V, Gas turbines, Tata McGraw-Hill Publication, New Delhi, 1999.
7. Somasundaram, Gas Dynamic and Jet propulsion, New Age Internatiolnal, 1996.
8. Arora .C.P., "Refrigeration and Air Conditioning", TMH, 1994.
9. Charles H Butler : Cogeneration" McGraw Hill, 1984.

ME8071 AUTOMOBILE ENGINEERING L T P C

3 0 0 3

OBJECTIVE:

- To provide a first course of teaching such that the learners are able to visualise the scope of Automobile Engineering.

UNIT I INTRODUCTON TO AUTOMOTIVES 10

An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Quality standards, Trends in automobile design.

UNIT II POWER SOURCE FEATURES 10

Reciprocating Engine systems, Rotary Engine systems, Gas Turbine systems, Hybrid systems. Pollutant emissions and their control; Catalytic converter systems, Electronic

Engine Management systems.

UNIT III TRANSMISSION, SUSPENSION AND BREAKING SYSTEMS 10

Clutch system, Gear box system, propeller shafting, differential, axles, wheels and tyres and prelimineries of suspension systems

UNIT IV OTHER AUXILIARY SYSTEMS 10

Electrical and electronic systems, safety systems, ***Heating, Ventilation, and Air Conditioning*** (HVAC) systems, Vehicle Thermal Management System and vehicle body design features.

UNIT V TESTS, SERVICE AND MAINTENANCE 5

Engine Tuning, vehicle maintenance, engine and Chassis Dynamometry Pollutants and emissions check, Wind Tunnel Tests, preliminaries of engine and vehicle testing.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students will be able to identify the different components in automobile engineering.
- Have clear understanding on different auxiliary and transmission systems usual.

TEXT BOOK:

1. Automotive Mechanics, William H. Course and Donals L. Anglin, Tata McGraw – Hill Publishing Company Ltd., 2004, Tenth Edition.

REFERENCES:

1. Automotive Handbook, Bosch, Robert Bosch GmbH, Germany, 2004, Sixth Edition.
2. Automotive Technology – A Systems Approach, Jack Erjavek, Thomson Learning, 3rd Edition, 1999.

ME8076 ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

OBJECTIVE:

Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS **9**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING **9**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/ CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS **9**

Sickness in small Business – Concept, Magnitude, causes and consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL: 45 PERIODS

OUTCOMES :

- Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

TEXT BOOkS:

1. S.S.Khanka "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi,1999.
2. Kuratko & Hodgetts, "Enterprenuership – Theory, process and practices", Thomson learning 6th edition.

REFERENCES:

1. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002.
2. Mathew J Manimala," Enterprenuership theory at cross roads: paradigms and praxis" Dream tech 2nd edition 2006.
3. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development" Institute of India, Ahmadabad, 1986.

ME8077 MARKETING MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVE:

- To understand the various processes involved in Marketing and its Philosophy.
- To learn the Psychology of consumers.
- To formulate strategies for advertising, pricing and selling

UNIT I MARKETING PROCESS **9**

Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts,

environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy

UNIT II BUYING BEHAVIOUR AND MARKET SEGMENTATION 9

Cultural, demographic factors, motives, types, buying decisions, segmentation factors - demographic -Psycho graphic and geographic segmentation, process, patterns.

UNIT III PRODUCT PRICING AND MARKETING RESEARCH 9

Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT IV PLANNING AND STRATEGY FORMULATION 9

Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

UNIT V ADVERTISING, SALES PROMOTION AND DISTRIBUTION 9

Characteristics, impact, goals, types, and sales promotions- point of purchase- unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

TOTAL: 45 PERIODS

OUTCOME

- The course will enable students the management philosophy pertaining to marketing, advertising, pricing and selling.

TEXT BOOKS:

1 Govindarajan. M, “Marketing management – concepts, cases, challenges and trends”, Prentice hall of India, second edition 2007.

2. Philip Kolter,Koshy Jha “Marketing Management”, Pearson Education ,Indian adapted edition 2007.

REFERENCES:

1. Ramasamy and Nama kumari, “Marketing Environment: Planning, implementation and control the Indian context”, 1990.
2. Czinkota&Kotabe, “Marketing management”, Thomson learning, Indian edition 2007
3. Adrain palmer, “ Introduction to marketing theory and practice”, Oxford university press IE 2004.
4. Donald S. Tull and Hawkins, “Marketing Reasearch”, Prentice Hall of Inida-1997.
5. Philip Kotler and Gary Armstrong “Principles of Marketing” Prentice Hall of India, 2000.
6. Steven J.Skinner, “Marketing”, All India Publishers and Distributes Ltd. 1998.
7. Graeme Drummond and John Ensor, Introduction to marketing concepts, Elsevier, Indian Reprint, 2002

ME8079 NON-TRADITIONAL MACHINING PROCESSES L T P C
3 0 0 3

OBJECTIVES:

- 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) "Production Technology", HMT Bangalore, Tata Mc Graw–Hill Publishing Company Limited, New Delhi, 2006.
2. Hassan El – Hofy "Advanced machining Processes" MC Graw-Hill, 2005.

ME8081 RELIABILITY CONCEPTS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

To impart knowledge in reliability concepts, reliability estimation methods and reliability improvement methods

UNIT I RELIABILITY CONCEPT 9

Reliability definition –Reliability parameters- f(t), F(t) and R(t) functions- Measures of central tendency – Bath tub curve – A priori and posteriori probabilities of failure – Component mortality - Useful life.

UNIT II LIFE DATA ANALYSIS 9

Data classification – Non parametric methods: Ungrouped, Grouped, Complete, Censored data – Time to failure distributions – Probability plotting: Exponential, Weibull - Goodness of fit tests – Survival graphs.

UNIT III RELIABILITY ESTIMATION 9

Series parallel configurations – Parallel redundancy – m/n system – Complex systems: RBD approach – Baye's method – Minimal path and cut sets - Fault Tree analysis – Standby system.

UNIT IV RELIABILITY MANAGEMENT 8

Reliability testing: Failure terminated test – Time terminated test – Upper and lower MTBFs – Sequential Testing – Reliability growth monitoring – Reliability allocation.

UNIT V RELIABILITY IMPROVEMENT 10

Analysis of downtime – Repair time distribution – Maintainability prediction – Measures of maintainability – Availability definitions – System Availability – Replacement decisions – Economic life.

TOTAL: 45 PERIODS

OUTCOME:

The course enable student the application of reliability in various field of engineering.

REFERENCES:

1. An Introduction to Reliability and Maintainability Engineering, Charles E.Ebeling, TMH,2000.
2. Roy Billington and Ronald N. Allan, Reliability Evaluation of Engineering Systems, Springer, 2007.
3. Reliability Engineering, Srinath L S, East West Publisher, 4th edition.

ME8752 FINITE ELEMENT ANALYSIS 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. Longitudinal vibration frequencies and mode shapes. 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 ADVANCED 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 BOOk:

1. J.N.Reddy, “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005

REFERENCE BOOkS:

1. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
2. Logan, D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2002.
4. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butter worth Heinemann, 2004
5. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice Hall College Div, 1990.

GE8072 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.

TEXTBOOK:

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

REFERENCES

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

GE8073 **HUMAN RIGHTS** **L T P C**
3 0 0 3

OBJECTIVES :

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