COURSE STRUCTURE AND SYLLABUS

FOR

METALLURGICAL ENGINEERING

(Applicable for batches admitted from 2016-2017)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India

I Year - I Semester

S.No.	Subjects	L	T	P	Credits
1-HS	English – I	4	--	--	3
2-BS	Mathematics - I	4	--	--	3
3-ES	Engineering Chemistry	4	--	--	3
4-BS	Engineering Mechanics	4	--	--	3
5-BS	Computer Programming	4	--	--	3
6-ES	Environmental Studies	4	--	--	3
7-HS	Engineering / Applied Chemistry Laboratory	--	--	3	2
8-BS	English - Communication Skills Lab - I	--	--	3	2
9-ES	Computer Programming Lab	--	--	3	2
	Total Credits				**24**

I Year - II Semester

S.No.	Subjects	L	T	P	Credits
1-HS	English – II	4	--	--	3
2-BS	Mathematics – II (Mathematical Methods)	4	--	--	3
3-BS	Mathematics – III	4	--	--	3
4-ES	Engineering Physics	4	--	--	3
5-HS	Basic Electrical and Electronics Engineering	4	--	--	3
6-ES	Engineering Drawing	4	--	--	3
7-BS	English - Communication Skills Lab - II	--	--	3	2
8-HS	Engineering/Applied Physics Lab	--	--	3	2
9-ES	Engineering Physics /Applied – Virtual Labs - Assignments	--	--	2	--
10	Engg.Workshop & IT Workshop	--	--	3	2
	Total Credits				**24**

II Year - I Semester

S.No.	Subjects	L	T	P	Credits
1	Probability and Statistics	4	--	--	3
2	Physical Metallurgy	4	--	--	3
3	Metallurgical Thermodynamics - I	4	--	--	3
4	Mechanics of Solids and Fluids	4	--	--	3
5	Principles of Extractive Metallurgy	4	--	--	3
6	Polymers	4	--	--	3
7	Physical Metallurgy Lab	--	--	3	2
8	Mechanics of Solids Lab	--	--	3	2
	Total Credits				**22**

II Year - II Semester

S.No.	Subjects	L	T	P	Credits
1	Mineral Processing	4	--	--	3
2	Iron Making	4	--	--	3
3	Fuels, Furnaces and Refractories	4	--	--	3
4	Metallurgical Thermodynamics -II	4	--	--	3
5	Non Ferrous Extractive Metallurgy	4	--	--	3
6	Alternative Sources of Energy	4	--	--	3
7	Mineral Processing Lab	--	--	3	2
8	Fuels and Metallurgical Analysis Lab	--	--	3	2
	Total Credits				**22**

III Year - I Semester

S.No.	Subjects	L	T	P	Credits
1	Foundry Technology	4	--	--	3
2	Steel Making	4	--	--	3
3	Managerial Economics and Financial Analysis	4	--	--	3
4	Phase Transformations and Heat - Treatment	4	--	--	3
5	Material Testing and Evaluation	4	--	--	3
6	Foundry Technology Lab	--	--	3	2
7	Heat Treatment Lab	--	--	3	2
8	Material Testing and Evaluation Lab	--	--	3	2
9	IPR & Patents	--	2	--	--
	Total Credits				**21**

III Year - II Semester

S.No.	Subjects	L	T	P	Credits
1	Materials Joining Techniques	4	--	--	3
2	Industrial Engineering and Management	4	--	--	3
3	Materials Characterization	4	--	--	3
4	Metal Forming	4	--	--	3
5	**OPEN ELECTIVE** 1. Waste Water Management 2. Robotics 3. DBMS 4. CAD/CAM 5. Functional Materials 6. Metallurgical Analysis	4	--	--	3
6	Materials Joining Lab	--	--	3	2
7	Metal Forming Lab	--	--	3	2
8	Materials Characterization Lab	--	--	3	2
9MC	Professional Ethics & Human Values	--	3	--	--
	Total Credits				**21**

IV Year - I Semester

S.No.	Subjects	L	T	P	Credits
1	Process Modelling	4	--	--	3
2	Electro Metallurgy and Corrosion	4	--	--	3
3	Ceramic Materials	4	--	--	3
4	Powder Metallurgy	4	--	--	3
5	**Elective I** 1. Nuclear Materials 2. Magnetic and Electronic Materials 3.Light Metals and Alloys	4	--	--	3
6	**Elective II** 1. High Temperature Materials 2. Metallurgical Failure Analysis 3. Bio-materials	4	--	--	3
7	Process Modelling Lab	--	--	2	2
8	Electro Metallurgy and Corrosion Lab	--	--	2	2
	Total Credits				**22**

IV Year - II Semester

S.No.	Subjects	L	T	P	Credits
1	Composite Materials	4	--	--	3
2	Ferro Alloy Technology	4	--	--	3
3	Nano-materials	4	--	--	3
4	**Elective III** 1. Surface Engineering 2. Ladle Metallurgy and Continuous Casting 3. Industrial Tribology	4	--	--	3
5	Seminar	--	3	--	2
6	Project	--	--	--	10
	Total Credits				**24**

Total Course Credits = 48+44 + 42 + 46 = 180

Syllabus

	L	T	P	C
I Year – I Semester	**4**	**0**	**0**	**3**

ENGLISH - I

Introduction:

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training the students to acquire communicative competence, the syllabus has been designed to develop linguistic and communicative competence of the students of Engineering.

As far as the detailed Textbooks are concerned, the focus should be on the skills of listening, speaking, reading and writing. The nondetailed Textbooks are meant for extensive reading for pleasure and profit.

Thus the stress in the syllabus in primarily on the development of communicative skills and fostering of ideas.

Objectives:

1. To imporve the language proficiency of the students in English with emphasis on LSRW skills.
2. To enable the students to study and comprehend the prescribed lessons and subjects more effectively relating to their theorotical and practical components.
3. To develop the communication skills of the students in both formal and informal situations.

LISTENING SKILLS:

Objectives:

1. To enable the students to appreciate the role of listening skill and improve their pronounciation.
2. To enable the students to comprehend the speech of people belonging to different backgrounds and regions.
3. To enable the students to listen for general content, to fill up information and for specific information.

SPEAKING SKILLS:

Objectives:

1. To make the students aware of the importance of speaking for their personal and professional communication.
2. To enable the students to express themselves fluently and accurately in social and professional success.
3. To help the students describe objects, situations and people.
4. To make the students participate in group activities like roleplays, discussions and debates.
5. To make the students particiapte in Just a Minute talks.

READING SKILLS:

Objectives:

1. To enable the students to comprehend a text through silent reading.
2. To enable the students to guess the meanings of words, messages and inferences of texts in given contexts.
3. To enable the students to skim and scan a text.
4. To enable the students to identify the topic sentence.
5. To enable the students to identify discourse features.
6. To enable the students to make intensive and extensive reading.

WRITING SKILLS:

Objectives:

1. To make the students understand that writing is an exact formal skills.
2. To enable the students to write sentences and paragraphs.
3. To make the students identify and use appropriate vocabulary.
4. To enable the students to narrate and describe.
5. To enable the students capable of note-making.
6. To enable the students to write coherently and cohesively.
7. To make the students to write formal and informal letters.
8. To enable the students to describe graphs using expressions of comparision.
9. To enable the students to write techincal reports.

Methodology:

1. The class are to be learner-centered where the learners are to read the texts to get a comprehensive idea of those texts on their own with the help of the peer group and the teacher.
2. Integrated skill development methodology has to be adopted with focus on individual language skills as per the tasks/exercise.
3. The tasks/exercises at the end of each unit should be completed by the learners only and the teacher interventionis perimitted as per the complexity of the task/exercise.
4. The teacher is expected to use supplementary material wherever necessary and also generate activities/tasks as per the requirement.
5. The teacher is perimitted to use lecture method when a completely new concept is introduced in the class.

Assessment Procedure: Theory

1. The formative and summative assessment procedures are to be adopted (mid exams and end semester examination).
2. Neither the formative nor summative assessment procedures should test the memory of the content of the texts given in the textbook. The themes and global comprehension of the units in the present day context with application of the langauge skills learnt in the unit are to be tested.
3. Only new unseen passages are to be given to test reading skills of the learners. Written skills are to be tested from sentence level to essay level. The communication formats—emails,letters and reports-- are to be tested along with appropriate langauge and expressions.
4. Examinations:
   I mid exam + II mid exam (15% for descriptive tests+10% for online tests)= 25%

   (80% for the best of two and 20% for the other)

   Assignments= 5%

   End semester exams=70%

5. Three take home assignments are to be given to the learners where they will have to read texts from the reference books list or other sources and write their gist in their own words.

The following text books are recommended for study in I B.Tech I Semester (Common for all branches)and I B.Pharma I Sem of JNTU Kakinada from the academic year 2016-17 (R-16 Regualtions)

DETAILED TEXTBOOK:

ENGLISH FOR ENGINEERS AND TECHNOLOGISTS, Published by **Orient Blackswan Pvt Ltd**

NON-DETAILED TEXTBOOK:

PANORAMA: A COURSE ON READING, Published by **Oxford University Press India**

The course content along with the study material is divided into six units.

UNIT I:

1. 'Human Resources' from English for Engineers and Technologists.

OBJECTIVE:

To develop human resources to serve the society in different ways.

OUTCOME:

The lesson motivates the readers to develop their knowledge different fields and serve the society accordingly.

2. 'An Ideal Family' from Panorama: A Course on Reading

OBJECTIVE:

To develop extensive reading skill and comprehension for pleasure and profit.

OUTCOME:

Acquisition of writing skills

UNIT 2:

1. ' Transport: Problems and Solutions' from English for Engineers and Technologists.

OBJECTIVE:

To highlight road safety measures whatever be the mode of transport.

OUTCOME:

The lesson motivates the public to adopt road safety measures.

2. 'War' from 'Panorama : A Course on Reading'

OBJECTIVE:

To develop extensive reading skill and comprehension for pleasure and profit.

OUTCOME:

Acquisition of writing skills

UNIT 3:

1. 'Evaluating Technology' from English for Engineers and Technologists.

OBJECTIVE:

To highlight the advantages and disadvantages of technology.

OUTCOME:

The lesson creates an awareness in the readers that mass production is ultimately detrimental to biological survival.

2. 'The Verger' from 'Panorama : A Course on Reading'

OBJECTIVE:

To develop extensive reading skill and comprehension for pleasure and profit.

OUTCOME:

Acquisition of writing skills

UNIT 4:

1. 'Alternative Sources of Energy' from English for Engineers and Technologists.

OBJECTIVE:

To bring into focus different sources of energy as alternatives to the depleting sources.

OUTCOME:

The lesson helps to choose a source of energy suitable for rural India.

2. ' The Scarecrow' from Panorama : A Course on Reading

OBJECTIVE:

To develop extensive reading skill and comprehension for pleasure and profit.

OUTCOME:

Acquisition of writing skills

UNIT 5:

1. 'Our Living Environment' from English for Engineers and Technologists.

OBJECTIVE:

To highlight the fact that animals must be preserved beacuase animal life is precious.

OUTCOME:

The lesson creates an awareness in the reader as to the usefulness of animals for the human society.

2. 'A Village Host to Nation' from Panorama : A Course on Reading

OBJECTIVE:

To develop extensive reading skill and comprehension for pleasure and profit.

OUTCOME:

Acquisition of writing skills

UNIT 6:

1. ' Safety and Training' from English for Engineers and Technologists.

OBJECTIVE:

To highlight the possibility of accidents in laboratories, industries and other places and to follow safety measures.

OUTCOME:

The lesson helps in identifying safety measures against different varieties of accidents at home and in the workplace.

2. 'Martin Luther King and Africa' from Panorama : A Course on Reading

OBJECTIVE:

To develop extensive reading skill and comprehension for pleasure and profit.

OUTCOME:

Acquisition of writing skills

NOTE:

All the exercises given in the prescribed lessons in both detailed and non-detailed textbooks relating to the theme and language skills must be covered.

OVERALL COURSE OUTCOME:

1. Using English languages, both written and spoken, competently and correctly.
2. Improving comprehension and fluency of speech.
3. Gaining confidence in using English in verbal situations.

MODEL QUESTION PAPER FOR THEORY

PART- I

Six short answer questions on 6 unit themes

One question on eliciting student's response to any of the themes

PART-II

Each question should be from one unit and the last question can be a combination of two or more units.

Each question should have 3 sub questions: A,B & C

A will be from the main text: 5 marks

B from non-detailed text: 3 marks

C on grammar and Vocabulary: 6 marks

I Year – I Semester

L	T	P	C
4	0	0	3

MATHEMATICS-I
(Common to ALL branches of First Year B.Tech.)

Course Objectives:

1. The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2. The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.

Course Outcomes: At the end of the Course, Student will be able to:

1. Solve linear differential equations of first, second and higher order.
2. Determine Laplace transform and inverse Laplace transform of various functions and use Laplace transforms to determine general solution to linear ODE.
3. Calculate total derivative, Jocobian and minima of functions of two variables.

UNIT I: Differential equations of first order and first degree:

Linear-Bernoulli-Exact-Reducible to exact.

Applications: Newton's Law of cooling-Law of natural growth and decay-Orthogonal trajectories- Electrical circuits- Chemical reactions.

UNIT II: Linear differential equations of higher order:

Non-homogeneous equations of higher order with constant coefficients with RHS term of the type e^{ax}, sin ax, cos ax, polynomials in x, e^{ax} V(x), xV(x)- Method of Variation of parameters.

Applications: LCR circuit, Simple Harmonic motion.

UNIT III: Laplace transforms:

Laplace transforms of standard functions-Shifting theorems - Transforms of derivatives and integrals – Unit step function –Dirac's delta function- Inverse Laplace transforms– Convolution theorem (with out proof).

Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

UNIT IV: Partial differentiation:

Introduction- Homogeneous function-Euler's theorem-Total derivative-Chain rule-Generalized Mean value theorem for single variable (without proof)-Taylor's and Mc Laurent's series expansion of functions of two variables– Functional dependence-Jacobian.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT V: First order Partial differential equations:
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions –solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

UNIT VI: Higher order Partial differential equations:
Solutions of Linear Partial differential equations with constant coefficients. RHS term of the type $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$. Classification of second order partial differential equations.

Text Books:

1. **B.S.Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **N.P.Bali**, Engineering Mathematics, Lakshmi Publications.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India
2. **Micheael Greenberg,** Advanced Engineering Mathematics, 9th edition, Pearson edn
3. **Dean G. Duffy,** Advanced engineering mathematics with MATLAB, CRC Press
4. **Peter O'neil,** Advanced Engineering Mathematics, Cengage Learning.
5. **Srimanta Pal, Subodh C.Bhunia**, Engineering Mathematics, Oxford University Press.
6. **Dass H.K., Rajnish Verma. Er.,** Higher Engineering Mathematics, S. Chand Co. Pvt. Ltd, Delhi.

I Year – I Semester

L	T	P	C
4	0	0	3

ENGINEERING CHEMISTRY
(CE, ME, PCE, PE, Met.E, Mining, Automobile, Aeronautical, Chemical, Bio.tech.)

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

Learning Objectives:

- Plastics are nowadays used in household appliances; also they are used as composites (FRP) in aerospace and automotive industries.
- Fuels as a source of energy are a basic need of any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence they are introduced.
- The basics for the construction of galvanic cells are introduced. Also if corrosion is to be controlled, one has to understand the mechanism of corrosion which itself is explained by electrochemical theory.
- With the increase in demand, a wide variety of materials are coming up; some of them have excellent engineering properties and a few of these materials are introduced.
- Water is a basic material in almost all the industries, more so where steam is generated and also where it is supplied for drinking purposes.
- Materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries are introduced. Also lubrication is introduced.

UNIT I: HIGH POLYMERS AND PLASTICS

Polymerisation:- Introduction- Mechanism of polymerization - Stereo regular polymers – methods of polymerization (emulsion and suspension) -Physical and mechanical properties – ***Plastics*** as engineering materials : advantages and limitations – Thermoplastics and Thermosetting plastics – Compounding and fabrication (4/5 techniques)- Preparation, properties and applications of polyethene, PVC, Bakelite Teflon and polycarbonates

Elastomers :- Natural rubber- compounding and vulcanization – Synthetic rubbers : Buna S, Buna N, Thiokol and polyurethanes – Applications of elastomers.
Composite materials & Fiber reinforced plastics – Biodegradable polymers – Conducting polymers.

UNIT II: FUEL TECHNOLOGY

Fuels – Introduction – Classification – Calorific value - HCV and LCV – Dulong's formula – Bomb calorimeter – Numerical problems – Coal — Proximate and ultimate analysis – Significance of the analyses – Liquid fuels – Petroleum- Refining – Cracking – Synthetic petrol –Petrol knocking – Diesel knocking - Octane and Cetane ratings – Anti-knock agents – Power alcohol – Bio-diesel – Gaseous fuels – Natural gas, LPG and CNG – Combustion – Calculation of air for the combustion of a fuel – Flue gas analysis – Orsat apparatus – Numerical problems on combustion.
Explosives:- Rocket fuels

UNIT III: ELECTROCHEMICAL CELLS AND CORROSION

Galvanic cells - Reversible and irreversible cells – Single electrode potential – Electro chemical series and uses of this series- Standard electrodes (Hydrogen and Calomel electrodes) - Concentration Cells – Batteries: Dry Cell - Ni-Cd cells - Ni-Metal hydride cells - Li cells - Zinc – air cells.
Corrosion :- Definition – Theories of Corrosion (chemical & electrochemical) – Formation of galvanic cells by different metals, by concentration cells, by differential aeration and waterline corrosion – Passivity of metals – Pitting corrosion - Galvanic series – Factors which influence the rate of corrosion - Protection from corrosion – Design and material selection – Cathodic protection - Protective coatings: – Surface preparation – Metallic (cathodic and anodic) coatings - Methods of application on metals (Galvanizing, Tinning, Electroplating, Electroless plating).

UNIT IV: CHEMISTRY OF ADVANCED MATERIALS

Nano materials:- Introduction – Sol-gel method & chemical reduction method of preparation – Characterization by BET method and TEM methods - Carbon nano tubes and fullerenes: Types, preparation, properties and applications
Liquid crystals:- Introduction – Types – Applications
Super conductors:-Type –I, Type II – Characteristics and applications
Green synthesis:- Principles - 3or 4 methods of synthesis with examples – R_4M_4 principles

UNIT V: WATER TECHNOLOGY

Hard water:- Reasons for hardness – units of hardness - determination of hardness and alkalinity - Water for steam generation - Boiler troubles – Priming and Foaming, Scale formation, Boiler corrosion, Caustic embrittlement - Internal treatments - Softening of Hard water : Lime – Soda process, Zeolite process and numerical problems based on these processes and Ion Exchange process - Water for drinking purposes- Purification – Sterilization and disinfection : Chlorination, Break point chlorination and other methods – Reverse Osmosis and Electro Dialysis.

UNIT VI: CHEMISTRY OF ENGINEERING MATERIALS AND FUEL CELLS

Refractories: - Definition, characteristics, classification, properties, failure of refractories

Lubricants: - Definition, function, Theory and mechanism of lubricants, properties (Definition and importance)

Cement: - Constituents, manufacturing, hardening and setting, deterioration of cement

Insulators: - Thermal and electrical insulators

Fuel cells: - Hydrogen Oxygen fuel cells – Methanol Oxygen fuel cells

Outcome: The advantages and limitations of plastic materials and their use in design would be understood. Fuels which are used commonly and their economics, advantages and limitations are discussed. Reasons for corrosion and some methods of corrosion control would be understood. The students would be now aware of materials like nano materials and fullerenes and their uses. Similarly liquid crystals and superconductors are understood. The importance of green synthesis is well understood and how they are different from conventional methods is also explained. The impurities present in raw water, problems associated with them and how to avoid them are understood. The advantages and limitations of plastic materials and their use in design would be understood. The commonly used industrial materials are introduced.

Standard Books:

1. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co.
2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2015 edition.

Reference Books:

1. Engineering Chemistry of Wiley India Pvt. Ltd., Vairam and others, 2014 edition (second).
2. Engineering Chemistry by Prasanth Rath, Cengage Learning, 2015 edition.
3. A text book of engineering Chemistry by S. S. Dara; S. Chand & Co Ltd., Latest Edition
4. Applied Chemistry by H.D. Gesser, Springer Publishers
5. Text book of Nano-science and nanotechnology by B.S. Murthy, P. Shankar and others, University Press, IIM

I Year – I Semester

L	T	P	C
4	0	0	3

ENIGINEERING MECHANICS

Objectives: The students completing this course are expected to understand the concepts of forces and its resolution in different planes ,resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work - energy method.

UNIT – I

Objectives: The students are to be exposed to the concepts of force and friction , direction and its application.

Introduction to Engg. Mechanics – Basic Concepts.

Systems of Forces : Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems. Introduction **,** limiting friction and impending motion, coulomb's laws of dry friction , coefficient of friction, cone of friction

UNIT II

Objectives: The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.

Equilibrium of Systems of Forces : Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, Spatial Systems for concurrent forces. Lamis Theorm, Graphical method for the equilibrium of coplanar forces, Converse of the law of Triangle of forces, converse of the law of polygon of forces condition of equilibrium, analysis of plane trusses.

UNIT – III

Objectives : The students are to be exposed to concepts of centre of gravity.

Centroid : Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity : Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, Pappus theorems.

UNIT IV

Objective: The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.

Area moments of Inertia : Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia :** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – V

Objectives : The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.

Kinematics : Rectilinear and Curvelinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion. **Kinetics :** Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

UNIT – VI

Objectives : The students are to be exposed to concepts of work , energy and particle motion

Work – Energy Method : Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

TEXT BOOKS :

1. Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw Hill publications.

REFERENCES :

1. Engineering Mechanics statics and dynamics – R.C.Hibbeler, 11th Edn – Pearson Publ.
2. Engineering Mechanics , statics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
3. Engineering Mechanics , statics and dynamics – I.H.Shames, – Pearson Publ.
4. Mechanics For Engineers , statics - F.P.Beer & E.R.Johnston – 5th Edn Mc Graw Hill Publ.
5. Mechanics For Engineers, dynamics - F.P.Beer & E.R.Johnston –5th Edn Mc Graw Hill Publ.
6. Theory & Problems of engineering mechanics, statics & dynamics – E.W.Nelson, C.L.Best & W.G. McLean, 5th Edn – Schaum's outline series - Mc Graw Hill Publ.
7. Engineering Mechanics , Fedinand . L. Singer , Harper – Collins.
8. Engineering Mechanics statics and dynamics , A Nelson , Mc Graw Hill publications

I Year – I SEMESTER

L	T	P	C
4	0	0	3

COMPUTER PROGRAMMING

OBJECTIVES:

Formulating algorithmic solutions to problems and implementing algorithms in C

Notion of Operation of a CPU, Notion of an algorithm and computational procedure, editing and executing programs in Linux

understanding branching, iteration and data representation using arrays

Modular programming and recursive solution formulation

Understanding pointers and dynamic memory allocation

Understanding miscellaneous aspects of C

Comprehension of file operations

UNIT-I:

History and Hardware - Computer Hardware, Bits and Bytes, Components, Programming Languages - Machine Language, Assembly Language, Low- and High-Level Languages, Procedural and Object-Oriented Languages, Application and System Software, The Development of C Algorithms The Software Development Process.

UNIT - II

Introduction to C Programming

Identifiers, The main() Function, The printf() Function

Programming Style - Indentation, Comments, Data Types**,** Arithmetic Operations, Expression Types, Variables and Declarations, Negation, Operator Precedence and Associativity, Declaration Statements, Initialization. **Assignment -** Implicit Type Conversions, Explicit Type Conversions (Casts), Assignment Variations, Mathematical Library Functions, Interactive Input, Formatted Output, Format Modifiers.

UNIT -III: Control Flow

Relational Expressions - Logical Operators

Selection: if-else Statement, nested if, examples, Multi-way selection: switch, else-if, examples.

Repetition: Basic Loop Structures, Pretest and Posttest Loops, Counter-Controlled and Condition-Controlled Loops, The while Statement,The for Statement, Nested Loops, The do-while Statement.

UNIT - IV Modular Programming

Function and Parameter Declarations, Returning a Value, Functions with Empty Parameter Lists, Variable Scope, Variable Storage Class, Local Variable Storage Classes Global Variable Storage Classes, Pass by Reference, Passing Addresses to a Function Storing Addresses, Using Addresses, Declaring and Using Pointers, Passing Addresses to a Function, Case Study: Swapping Values, Recursion - Mathematical Recursion, Recursion versus Iteration.

UNIV - V - Arrays & Strings

Arrays

One-Dimensional Arrays, Input and Output of Array Values, Array Initialization, Arrays as Function Arguments, Two-Dimensional Arrays, Larger Dimensional Arrays - Matrices

Strings

String Fundamentals, String Input and Output, String Processing, Library Functions

UNIT- VI Pointers, Structures, Files

Pointers: Concept of a Pointer, Initialisation of pointer variables, pointers as function arguments, passing by address, Dangling memory, address arithmetic, character pointers and functions, pointers to pointers, Dynamic memory management functions, command line arguments.

Structures: Derived types, Structures declaration, Initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit-fields.

Data Files : Declaring, Opening, and Closing File Streams, Reading from and Writing to Text Files, Random File Access

OUTCOMES:

1. Understand the basic terminology used in computer programming
2. Write, compile and debug programs in C language.
3. Use different data types in a computer program.
4. Design programs involving decision structures, loops and functions.
5. Explain the difference between call by value and call by reference
6. Understand the dynamics of memory by the use of pointers
7. Use different data structures and create/update basic data files.

TEXT BOOKS:

1. ANSI C Programming, Gary J. Bronson, Cengage Learning.
2. Programming in C, Bl Juneja Anita Seth, Cengage Learning.
3. The C programming Language by Dennis Richie and Brian Kernighan, Pearson Education

REFERENCE:

1. C Programming, A Problem Solving Approach, Forouzan, Gilberg, CENGAGE
2. Programming with C, Bichkar, Universities Press
3. Programming in C, Reema Thareja, OXFORD
4. C by Example, Noel Kalicharan, Cambridge

I Year – I Semester

L	T	P	C
4	0	0	3

ENVIRONMENTAL STUDIES

Course Learning Objectives:

The objectives of the course is to impart

1. Overall understanding of the natural resources
2. Basic understanding of the ecosystem and its diversity
3. Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities
4. An understanding of the environmental impact of developmental activities
5. Awareness on the social issues, environmental legislation and global treaties

Course Outcomes:

The student should have knowledge on

1. The natural resources and their importance for the sustenance of the life and recognise the need to conserve the natural resources
2. The concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web
3. The biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity
4. Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management practices
5. Social issues both rural and urban environment and the possible means to combat the challenges
6. The environmental legislations of India and the first global initiatives towards sustainable development.
7. About environmental assessment and the stages involved in EIA and the environmental audit

Syllabus:

UNIT - I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance –Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information Technology in Environment and human health.

Ecosystems: 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 Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT - II

Natural Resources: Natural resources and associated problems

Forest resources – Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest 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

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT - III

Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

UNIT – IV Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

UNIT – V Social Issues and the Environment: Urban problems related to energy - Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.

UNIT – VI Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.

The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:

1. Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
3. Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

Reference:

1. Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014

***

I Year – I Semester

L	T	P	C
0	0	3	2

ENGINEERING / APPLIED CHEMISTRY LABORATORY
(Common to all branches)

1. Introduction to Chemistry laboratory – Molarity, Normality, Primary, secondary standard solutions, Volumetric titrations, Quantitative analysis, Qualitative analysis, etc.
2. Trial experiment - Determination of HCl using standard Na_2CO_3 solution.
3. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
4. Determination of $KMnO_4$ using standard Oxalic acid solution.
5. Determination of Ferrous iron using standard $K_2Cr_2O_7$ solution.
6. Determination of Copper using standard $K_2Cr_2O_7$ solution.
7. Determination of temporary and permanent hardness of water using standard EDTA solution.
8. Determination of Copper using standard EDTA solution.
9. Determination of Iron by a Colorimetric method using thiocynate as reagent.
10. Determination of pH of the given sample solution using pH meter.
11. Conductometric titration between strong acid and strong base.
12. Conductometric titration between strong acid and weak base.
13. Potentiometric titration between strong acid and strong base.
14. Potentiometric titration between strong acid and weak base.
15. Determination of Zinc using standard EDTA solution.
16. Determination of Vitamin – C.

Outcomes: The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

Reference Books

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.
2. Dr. Jyotsna Cherukuris (2012) *Laboratory Manual of engineering chemistry-II,* VGS Techno Series
3. Chemistry Practical Manual, Lorven Publications
4. K. Mukkanti (2009) *Practical Engineering Chemistry,* B.S. Publication

I Year – I Semester

L	T	P	C
0	0	3	2

ENGLISH - COMMUNICATION SKILLS LAB-I

PRESCRIBED LAB MANUAL FOR SEMESTER I:

'INTERACT: English Lab Manual for Undergraduate Students' Published by **Orient Blackswan Pvt Ltd.**

OBJECTIVES:

To enable the students to learn through practice the communication skills of listening, speaking, reading and writing.

OUTCOME:

A study of the communicative items in the laboratory will help the students become successful in the competitive world.

The course content along with the study material is divided into six units.

UNIT 1:

1. WHY study Spoken English?
2. Making Inqueries on the phone, thanking and responding to Thanks
   Practice work.

UNIT 2:

1. Responding to Requests and asking for Directions
   Practice work.

UNIT 3:

1. Asking for Clarifications, Inviting, Expressing Sympathy, Congratulating
2. Apologising, Advising, Suggesting, Agreeing and Disagreeing
   Practice work.

UNIT 4:

1. Letters and Sounds
   Practice work.

UNIT 5:

1. The Sounds of English
   Practice work.

UNIT 6:

1. Pronunciation
2. Stress and Intonation
   Practice work.

Assessment Procedure: Laboratory

1. Every lab session (150 minutes) should be handled by not less than two teachers (three would be ideal) where each faculty has to conduct a speaking activity for 20/30 students.
2. The teachers are to assess each learner in the class for not less than 10 speaking activities, each one to be assessed for 10 marks or 10%. The average of 10 day-to-day activity assessments is to be calculated for 10 marks for internal assessment.

The rubric given below has to be filled in for all the students for all activities.

The rubric to assess the learners:

	Body language		Fluency & Audibility	Clarity in Speech	Neutralization of accent	Appropriate Language		Total 10 marks	Remarks
	Gestures & Postures	Eye Contact				Grammar	Vocabulary & expressions		

- **Lab Assessment: Internal (25 marks)**
  1. Day-to-Day activities: 10 marks

  2. Completing the exercises in the lab manual: 5 marks

  3. Internal test (5 marks written and 5 marks oral)

- **Lab Assessment: External (50 marks)**
  1. Written test: 20 marks (writing a dialogue, note-taking and answering questions on listening to an audio recording.

  2. Oral: Reading aloud a text or a dialogue- 10 marks

  3. Viva-Voce by the external examiner: 20 marks

Reference Books:

1. Strengthen your communication skills by Dr M Hari Prasad, Dr Salivendra Raju and Dr G Suvarna Lakshmi, Maruti Publications.
2. English for Professionals by Prof Eliah, B.S Publications, Hyderabad.
3. Unlock, Listening and speaking skills 2, Cambridge University Press
4. Spring Board to Success, Orient BlackSwan
5. A Practical Course in effective english speaking skills, PHI
6. Word power made handy, Dr shalini verma, Schand Company
7. Let us hear them speak, Jayashree Mohanraj, Sage texts
8. Professional Communication, Aruna Koneru, Mc Grawhill Education
9. Cornerstone, Developing soft skills, Pearson Education
10. Education

I Year – I Semester

L	T	P	C
0	0	3	2

COMPUTER PROGRAMMING LAB

OBJECTIVES:

- Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures and File programming.
- Acquire knowledge about the basic concept of writing a program.
- Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.
- Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.
- Role of Functions involving the idea of modularity.

Programming

Exercise - 1 Basics

a) What is an OS Command, Familiarization of Editors - vi, Emacs
b) Using commands like mkdir, ls, cp, mv, cat, pwd, and man
c) C Program to Perform Adding, Subtraction, Multiplication and Division of two numbers From Command line

Exercise - 2 Basic Math

a) Write a C Program to Simulate 3 Laws at Motion
b) Write a C Program to convert Celsius to Fahrenheit and vice versa

Exercise - 3 Control Flow - I

a)Write a C Program to Find Whether the Given Year is a Leap Year or not.
b)Write a C Program to Add Digits & Multiplication of a number

Exercise – 4 Control Flow - II

a)Write a C Program to Find Whether the Given Number is
  i) Prime Number
  ii) Armstrong Number
b) Write a C program to print Floyd Triangle
c) Write a C Program to print Pascal Triangle

Exercise – 5 Functions

a) Write a C Program demonstrating of parameter passing in Functions and returning values.
b) Write a C Program illustrating Fibonacci, Factorial with Recursion without Recursion

Exercise – 6 Control Flow - III

a) Write a C Program to make a simple Calculator to Add, Subtract, Multiply or Divide Using switch…case

b) Write a C Program to convert decimal to binary and hex (using switch call function the function)

Exercise – 7 Functions - Continued

Write a C Program to compute the values ofsin x and cos x and e^x values using Series expansion. (use factorial function)

Exercise – 8 Arrays

Demonstration of arrays

a) Search-Linear.

b) Sorting-Bubble, Selection.

c) Operations on Matrix.

Exercises - 9 Structures

a)Write a C Program to Store Information of a Movie Using Structure

b)Write a C Program to Store Information Using Structures with Dynamically Memory Allocation

c) Write a C Program to Add Two Complex Numbers by Passing Structure to a Function

Exercise - 10 Arrays and Pointers

a)Write a C Program to Access Elements of an Array Using Pointer

b) Write a C Program to find the sum of numbers with arrays and pointers.

Exercise – 11 Dynamic Memory Allocations

a) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.

b) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function.

Understand the difference between the above two programs

Exercise – 12 Strings

a) Implementation of string manipulation operations **with** library function.

i) copy
ii) concatenate
iii) length
iv) compare

b) Implementation of string manipulation operations **without** library function.

i) copy
ii) concatenate
iii) length
iv) compare

Exercise -13 Files

a)Write a C programming code to open a file and to print it contents on screen.

b)Write a C program to copy files

Exercise - 14 Files Continued

a) Write a C program merges two files and stores their contents in another file.

b)Write a C program to delete a file.

OUTCOMES:

• Apply and practice logical ability to solve the problems.

• Understand C programming development environment, compiling, debugging, and linking and executing a program using the development environment

• Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs

• Understand and apply the in-built functions and customized functions for solving the problems.

• Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems.

• Document and present the algorithms, flowcharts and programs in form of user-manuals

•Identification of various computer components, Installation of software

Note:

a) All the Programs must be executed in the Linux Environment. (Mandatory)

b) The Lab record must be a print of the LATEX (.tex) Format.

I Year – II Semester

L	T	P	C
4	0	0	3

ENGLISH -II

The following text books are recommended for study in I B.Tech II Semester (Common for all branches) and I B.Pharma II Sem of JNTU Kakinada from the academic year 2016-17 **(R-16 Regulations)**

DETAILED TEXTBOOK: ENGLISH ENCOUNTERS Published by **Maruthi Publishers**.

DETAILED NON-DETAIL:THE GREAT INDIAN SCIENTISTS Published by **Cenguage learning**

The course content along with the study material is divided into six units.

UNIT 1:

1. ' The Greatest Resource- Education' from English Encounters

OBJECTIVE:

Schumacher describes the education system by saying that it was mere training, something more than mere knowledge of facts.

OUTCOME:

The lesson underscores that the ultimate aim of Education is to enhance wisdom.

2. ' A P J Abdul Kalam' from The Great Indian Scientists.

OBJECTIVE:

The lesson highlights Abdul Kalam's contributions to Indian science and the awards he received.

OUTCOME:

Abdul Kalam's simple life and service to the nation inspires the readers to follow in his footsteps.

UNIT 2:

1. ' A Dilemma' from English Encounters

OBJECTIVE: The lesson centres on the pros and cons of the development of science and technology.

OUTCOME: The lesson enables the students to promote peaceful co-existence and universal harmony among people and society.

2. 'C V Raman' from The Great Indian Scientists.

OBJECTIVE:

The lesson highlights the dedicated research work of C V Raman and his achievements in Physics.

OUTCOME:

The Achievements of C V Raman are inspiring and exemplary to the readers and all scientists.

UNIT 3:

1. 'Cultural Shock': Adjustments to new Cultural Environments from English Encounters.

OBJECTIVE:

The lesson depicts of the symptoms of Cultural Shock and the aftermath consequences.

OUTCOME:

The lesson imparts the students to manage different cultural shocks due to globalization.

2. 'Homi Jehangir Bhabha' from The Great Indian Scientists.

OBJECTIVE:

The lesson highlights Homi Jehangir Bhabha's contributions to Indian nuclear programme as architect.

OUTCOME:

The seminal contributions of Homi Jehangir Bhabha to Indian nuclear programme provide an aspiration to the readers to serve the nation and sterngthen it.

UNIT 4:

1. 'The Lottery' from English Encounters.

OBJECTIVE:

The lesson highlights insightful commentary on cultural traditions.

OUTCOME:

The theme projects society's need to re examine its traditions when they are outdated.

2. 'Jagadish Chandra Bose' from The Great Indian Scientists.

OBJECTIVE:

The lesson gives an account of the unique discoveries and inventions of Jagadish Chandra Bose in Science.

OUTCOME: The Scientific discoveries and inventions of Jagadish Chandra Bose provide inspiration to the readers to make their own contributions to science and technology, and strengthen the nation.

UNIT 5:

1. ' The Health Threats of Climate Change' from English Encounters.

OBJECTIVE:

The essay presents several health disorders that spring out due to environmental changes

OUTCOME:

The lesson offers several inputs to protect environment for the sustainability of the future generations.

2. ' Prafulla Chandra Ray' from The Great Indian Scientists.

OBJECTIVE:

The lesson given an account of the experiments and discoveries in Pharmaceuticals of Prafulla Chandra Ray.

OUTCOME:

Prafulla Chandra Ray's scientific achievements and patriotic fervour provide inspiration to the reader.

UNIT 6:

1. ' The Chief Software Architect' from English Encounters

OBJECTIVE:

The lesson supports the developments of technology for the betterment of human life.

OUTCOME:

Pupil get inspired by eminent personalities who toiled for the present day advancement of software development.

2. ' Srinivasa Ramanujan' from The Great Indian Scientists.

OBJECTIVE:

The lesson highlights the extraordinary achievements of Srinivasa Ramanujan, a great mathematician and the most romantic figure in mathematics.

OUTCOME:

The lesson provides inspiration to the readers to think and tap their innate talents.

NOTE:

All the exercises given in the prescribed lessons in both detailed and non-detailed textbooks relating to the theme and language skills must be covered.

		L	T	P	C
I Year – II Semester	**MATHEMATICS-II (Mathamatical Methods)**	**4**	**0**	**0**	**3**

Course Objectives:

1. The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2. The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.
3. Understand the most basic numerical methods to solve simultaneous linear equations.

Course Outcomes: At the end of the Course, Student will be able to:

1. Calculate a root of algebraic and transcendental equations. Explain relation between the finite difference operators.
2. Compute interpolating polynomial for the given data.
3. Solve ordinary differential equations numerically using Euler's and RK method.
4. Find Fourier series and Fourier transforms for certain functions.
5. Identify/classify and solve the different types of partial differential equations.

UNIT I: Solution of Algebraic and Transcendental Equations:

Introduction- Bisection method – Method of false position – Iteration method – Newton-Raphson method (One variable and simultaneous Equations).

UNIT II: Interpolation:

Introduction- Errors in polynomial interpolation – Finite differences- Forward differences- Backward differences –Central differences – Symbolic relations and separation of symbols - Differences of a polynomial-Newton's formulae for interpolation – Interpolation with unequal intervals - Lagrange's interpolation formula.

UNIT III: Numerical Integration and solution of Ordinary Differential equations:

Trapezoidal rule- Simpson's $1/3^{rd}$ and $3/8^{th}$ rule-Solution of ordinary differential equations by Taylor's series-Picard's method of successive approximations-Euler's method - Runge-Kutta method (second and fourth order).

UNIT IV: Fourier Series:

Introduction- Periodic functions – Fourier series of -periodic function - Dirichlet's conditions – Even and odd functions –Change of interval– Half-range sine and cosine series.

UNIT V: Applications of PDE:
Method of separation of Variables- Solution of One dimensional Wave, Heat and two-dimensional Laplace equation.

UNIT VI: Fourier Transforms:
Fourier integral theorem (without proof) – Fourier sine and cosine integrals - sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

Text Books:

1. **B.S.Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **N.P.Bali**, Engineering Mathematics, Lakshmi Publications.

Reference Books:

1. **Dean G. Duffy,** Advanced engineering mathematics with MATLAB, CRC Press
2. **V.Ravindranath and P.Vijayalakshmi,** Mathematical Methods, Himalaya Publishing House.
3. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India
4. **David Kincaid, Ward Cheney**, Numerical Analysis-Mathematics of Scientific Computing, 3rd Edition, Universities Press.
5. **Srimanta Pal, Subodh C.Bhunia**, Engineering Mathematics, Oxford University Press.
6. **Dass H.K., Rajnish Verma. Er.,** Higher Engineering Mathematics, S. Chand Co. Pvt. Ltd, Delhi.

I Year – II Semester **MATHEMATICS-III**

L	T	P	C
4	0	0	3

Course Objectives:

1. The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2. The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.
3. Understand the most basic numerical methods to solve simultaneous linear equations.

Course Outcomes: At the end of the Course, Student will be able to:

1. Determine rank, Eigenvalues and Eigen vectors of a given matrix and solve simultaneous linear equations.
2. Solve simultaneous linear equations numerically using various matrix methods.
3. Determine double integral over a region and triple integral over a volume.
4. Calculate gradient of a scalar function, divergence and curl of a vector function. Determine line, surface and volume integrals. Apply Green, Stokes and Gauss divergence theorems to calculate line, surface and volume integrals.

UNIT I: Linear systems of equations:

Rank-Echelon form-Normal form – Solution of linear systems – Gauss elimination - Gauss Jordon-Gauss Jacobi and Gauss Seidal methods.Applications: Finding the current in electrical circuits.

UNIT II: Eigen values - Eigen vectors and Quadratic forms:

Eigen values - Eigen vectors– Properties – Cayley-Hamilton theorem - Inverse and powers of a matrix by using Cayley-Hamilton theorem- Diagonalization- Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, negative and semi definite - Index – Signature.
Applications: Free vibration of a two-mass system.

UNIT III: Multiple integrals:

Curve tracing: Cartesian, Polar and Parametric forms.
Multiple integrals: Double and triple integrals – Change of variables – Change of order of integration.
Applications: Finding Areas and Volumes.

UNIT IV: Special functions:

Beta and Gamma functions- Properties - Relation between Beta and Gamma functions- Evaluation of improper integrals.
Applications: Evaluation of integrals.

UNIT V: Vector Differentiation:

Gradient- Divergence- Curl - Laplacian and second order operators -Vector identities.
Applications: Equation of continuity, potential surfaces

UNIT VI: Vector Integration:

Line integral – Work done – Potential function – Area- Surface and volume integrals Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and related problems.
Applications: Work done, Force.

Text Books:

1. **B.S.Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **N.P.Bali**, Engineering Mathematics, Lakshmi Publications.

Reference Books:

1. **Greenberg,** Advanced Engineering Mathematics, 2nd edition, Pearson edn
2. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India
3. **Peter O'Neil,** Advanced Engineering Mathematics,7th edition, Cengage Learning.
4. **D.W. Jordan and T.Smith,** Mathematical Techniques, Oxford University Press.
5. **Srimanta Pal, Subodh C.Bhunia**, Engineering Mathematics, Oxford University Press.
6. **Dass H.K., Rajnish Verma. Er.,** Higher Engineering Mathematics, S. Chand Co. Pvt. Ltd, Delhi.

I Year – II Semester **ENGINEERING PHYSICS**

L	T	P	C
4	0	0	3

(ME, CE, PE, PCE, MET.E, MINING, AUTOMOBILE, CHEMICAL,AERONAUTICAL, BIO.TECH)

OBJECTIVES: *Physics curriculum which is re-oriented to the needs of Circuital branches of graduate engineering courses offered by JNTUniv.Kkd. that serves as a transit to understand the branch specific advanced topics. The courses are designed to:*

- *Impart concepts of Optical Interference, Diffraction and Polarization required to design instruments with higher resolution - Concepts of coherent sources, its realization and utility optical instrumentation.*
- *Study the Structure-property relationship exhibited by solid crystal materials for their utility.*
- *Tap the Simple harmonic motion and its adaptability for improved acoustic quality of concert halls.*
- *To explore the Nuclear Power as a reliable source required to run industries*
- *To impart the knowledge of materials with characteristic utility in appliances.*

UNIT-I

INTERFERENCE: Principle of Superposition – Coherent Sources – Interference in thin films (reflection geometry) – Newton's rings – construction and basic principle of Interferometers.

UNIT-II

DIFFRACTION: Fraunhofer diffraction at single slit cases of double slit, N-slits & Circular Aperture (Qualitative treatment only)-Grating equation - Resolving power of a grating, Telescope and Microscopes.

UNIT-III

POLARIZATION: Types of Polarization-production - Nicol Prism -Quarter wave plate and Half Wave plate – Working principle of Polarimeter (Sacharimeter)

LASERS: Characteristics– Stimulated emission – Einstein's Transition Probabilities- Pumping schemes - Ruby laser – Helium Neon laser.

UNIT-IV

ACOUSTICS: Reverberation time - Sabine's formula – Acoustics of concert-hall.
ULTRASONICS: Production - Ultrasonic transducers- Non-Destructive Testing – Applications.

UNIT-V

CRYSTALLOGRAPHY & X-RAY DIFFRACTION: Basis and lattice – Bravais systems- Symmetry elements- Unit cell- packing fraction – coordination number- Miller indices – Separation between successive (h k l) planes – Bragg's law.

NUCLEAR ENERGY – SOURCE OF POWER: Mass defect & Binding Energy – Fusion and Fission as sources – Fast breeder Reactors.

UNIT-VI

MAGNETISM: Classification based on Field, Temperature and order/disorder –atomic origin – Ferromagnetism- Hysteresis- applications of magnetic materials (Para &Ferro)..

DIELECTRICS: Electric Polarization – Dielectrics in DC and AC fields – Internal field – Clausius Mossoti Equation - Loss, Breakdown and strength of dielectric materials – Ferroelectric Hysteresis and applications.

Outcome*: Construction and working details of instruments, ie., Interferometer, Diffractometer and Polarimeter are learnt. Study Acoustics, crystallography magnetic and dielectric materials enhances the utility aspects of materials.*

Text Books:

1. A Text book of Engineering Physics – by Dr. M.N.Avadhanulu and Dr.P.G.Kshirasagar, S.Chand & Company Ltd., (2014)
2. Physics for Engineers by M.R.Srinasan, New Age international publishers (2009)
3. Engineering Physics by D.K.Bhattacharya and Poonam Tandon , Oxford press (2015)

Refference books:

1. Applied Physics by P.K.Palanisamy , Scitech publications (2014)
2. Lasers and Non-Linear optics by B.B.Laud , Newage international publishers (2008)

I Year – II Semester

L	T	P	C
4	0	0	3

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Preamble:
This course covers the topics related to analysis of various electrical circuits, operation of various electrical machines, various electronic components to perform well in their respective fields.

Learning Objectives:
- To learn the basic principles of electrical circuital law's and analysis of networks.
- To understand the principle of operation and construction details of DC machines & Transformers.
- To understand the principle of operation and construction details of alternator and 3-Phase induction motor.
- To study the operation of PN junction diode, half wave, full wave rectifiers and OP-AMPs.
- To learn the operation of PNP and NPN transistors and various amplifiers.

UNIT - I
Electrical Circuits:
Basic definitions - Types of network elements - Ohm's Law - Kirchhoff's Laws - Inductive networks - Capacitive networks – Series - Parallel circuits - Star-delta and delta-star transformations.

UNIT - II
Dc Machines:
Principle of operation of DC generator – EMF equation - Types of DC machine – Torque equation – Applications – Three point starter - Speed control methods of DC motor – Swinburne's Test.

UNIT - III
Transformers:
Principle of operation and construction of single phase transformers – EMF equation – Losses – OC & SC tests - Efficiency and regulation.

UNIT - IV
AC Rotating Machines:
Principle of operation and construction of alternators– Types of alternators – Principle of operation of synchronous motor - Principle of operation of 3-Phase induction motor – Slip-torque characteristics - Efficiency – Applications.

UNIT V

Rectifiers & Linear ICs:

PN junction diodes - Diode applications(Half wave and bridge rectifiers).Characteristicsof operation amplifiers (OP-AMP) - application of OP-AMPs (inverting, non-inverting,integrator and differentiator).

UNIT VI

Transistors:

PNP and NPN junction transistor, transistor as an amplifier- Transistor amplifier - Frequency response of CE amplifier - Concepts of feedback amplifier.

Learning Outcomes:

- Able to analyse the various electrical networks.
- Able to understand the operation of DC generators,3-point starter and DC machine testing by Swinburne's Test.
- Able to analyse the performance of single-phase transformer.
- Able to explain the operation of 3-phase alternator and 3-phase induction motors.
- Able to analyse the operation of half wave, full wave bridge rectifiers and OP-AMPs.
- Able to explain the single stage CE amplifier and concept of feedback amplifier.

Text Books:

1. Electrical Technology by Surinder Pal Bali, Pearson Publications.
2. Electronic Devices and Circuits, R.L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.

ReferenceBooks:

1.Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group
2. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah,TMH Publications
3.Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications,2nd edition
4.Basic Electrical Engineering by Nagsarkar,Sukhija, Oxford Publications,2nd edition
5.Industrial Electronics by G.K. Mittal, PHI

I Year – II Semester

	L	T	P	C
ENGINEERING DRAWING	**4**	**0**	**0**	**3**

Objective: Engineering drawing being the principle method of communication for engineers, the objective is to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

UNIT I

Objective: To introduce the students to use drawing instruments and to draw polygons, Engg. Curves.

Polygons: Constructing regular polygons by general methods, inscribing and describing polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by general and special methods, cycloids, involutes, tangents & normals for the curves.

UNIT II

Objective: To introduce the students to use scales and orthographic projections, projections of points & simple lines.

Scales: Plain scales, diagonal scales and vernier scales

Orthographic Projections: Horizontal plane, vertical plane, profile plane, importance of reference lines, projections of points in various quadrants, projections of lines, lines parallel either to of the reference planes (HP,VP or PP)

UNIT III

Objective: The objective is to make the students draw the projections of the lines inclined to both the planes.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces- HT, VT

UNIT IV

Objective: The objective is to make the students draw the projections of the plane inclined to both the planes.

Projections of planes: regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT V

Objective: The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes.

UNIT VI

Objective: The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

REFERENCE BOOKS:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers

I Year – II Semester	ENGLISH - COMMUNICATION SKILLS LAB- II	L	T	P	C
		0	0	3	2

PRESCRIBED LAB MANUAL FOR SEMESTER II:

'INTERACT: English Lab Manual for Undergraduate Students' Published by **Orient Blackswan Pvt Ltd.**

OBJECTIVES:

To enable the students to learn demonstratively the communication skills of listening, speaking, reading and writing.

OUTCOME:

A study of the communicative items in the laboratory will help the students become successful in the competitive world.

The course content along with the study material is divided into six units.

UNIT 1:

1. Debating
   Practice work

UNIT 2:

1. Group Discussions
   Practice work

UNIT 3:

1. Presentation Skills
   Practice work

UNIT 4:

1. Interview Skills
   Practice work

UNIT 5:

1. Email,
2. Curriculum Vitae
   Practice work

UNIT 6:

1. Idiomatic Expressions
2. Common Errors in English
   Practice work

Reference Books:

1. Strengthen your communication skills by Dr M Hari Prasad, Dr Salivendra Raju and Dr G Suvarna Lakshmi, Maruti Publications.
2. English for Professionals by Prof Eliah, B.S Publications, Hyderabad.
3. Unlock, Listening and speaking skills 2, Cambridge University Press
4. Spring Board to Success, Orient BlackSwan
5. A Practical Course in effective english speaking skills, PHI
6. Word power made handy, Dr shalini verma, Schand Company
7. Let us hear them speak, Jayashree Mohanraj, Sage texts
8. Professional Communication, Aruna Koneru, Mc Grawhill Education
9. Cornerstone, Developing soft skills, Pearson Education

I Year – II Semester	ENGINEERING / APPLIED PHYSICS LAB	L	T	P	C
		0	0	3	2

(Any 10 of the following listed experiments)

Objective: *Training field oriented Engineering graduates to handle instruments and their design methods to improve the accuracy of measurements.*

LIST OF EXPERIMENTS:

1. Determination of wavelength of a source-Diffraction Grating-Normal incidence.
2. Newton's rings – Radius of Curvature of Plano - Convex Lens.
3. Determination of thickness of a spacer using wedge film and parallel interference fringes.
4. Determination of Rigidity modulus of a material- Torsional Pendulum.
5. Determination of Acceleration due to Gravity and Radius of Gyration- Compound Pendulum.
6. Melde's experiment – Transverse and Longitudinal modes.
7. Verification of laws of vibrations in stretched strings – Sonometer.
8. Determination of velocity of sound – Volume Resonator.
9. L- C- R Series Resonance Circuit.
10. Study of I/V Characteristics of Semiconductor diode.
11. I/V characteristics of Zener diode.
12. Characteristics of Thermistor – Temperature Coefficients.
13. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
14. Energy Band gap of a Semiconductor p - n junction.
15. Hall Effect in semiconductors.
16. Time constant of CR circuit.
17. Determination of wavelength of laser source using diffraction grating.
18. Determination of Young's modulus by method of single cantilever oscillations.
19. Determination of lattice constant – lattice dimensions kit.
20. Determination of Planck's constant using photocell.
21. Determination of surface tension of liquid by capillary rise method.

Outcome: *Physics lab curriculum gives fundamental understanding of design of an instrument with targeted accuracy for physical measurements.*

I Year – II Semester	ENGINEERING / APPLIED PHYSICS - VIRTUAL LABS – ASSIGNMENTS	L	T	P	C
		0	0	2	0

Constitutes 5% marks of 30marks of Internal-component)

Objective: *Training Engineering students to prepare a technical document and improving their writing skills.*

LIST OF EXPERIMENTS

1. Hall Effect
2. Crystal Structure
3. Hysteresis
4. Brewster's angle
5. Magnetic Levitation / SQUID
6. Numerical Aperture of Optical fiber
7. Photoelectric Effect
8. Simple Harmonic Motion
9. Damped Harmonic Motion
10. LASER – Beam Divergence and Spot size
11. B-H curve
12. Michelson's interferometer
13. Black body radiation

URL: ***www.vlab.co.in***

Outcome: *Physics Virtual laboratory curriculum in the form of assignment ensures an engineering graduate to prepare a /technical/mini-project/ experimental report with scientific temper.*

I Year – II Semester

T	P	C
0	3	2

ENGINEERING WORKSHOP & IT WORKSHOP

ENGINEERING WORKSHOP:

Course Objective: To impart hands-on practice on basic engineering trades and skills.
Note: At least two exercises to be done from each trade.

Trade:

Carpentry	1. T-Lap Joint
	2. Cross Lap Joint
	3. Dovetail Joint
	4. Mortise and Tennon Joint
Fitting	1. Vee Fit
	2. Square Fit
	3. Half Round Fit
	4. Dovetail Fit
Black Smithy	1. Round rod to Square
	2. S-Hook
	3. Round Rod to Flat Ring
	4. Round Rod to Square headed bolt
House Wiring	1. Parallel / Series Connection of three bulbs
	2. Stair Case wiring
	3. Florescent Lamp Fitting
	4. Measurement of Earth Resistance
Tin Smithy	1. Taper Tray
	2. Square Box without lid
	3. Open Scoop
	4. Funnel

IT WORKSHOP

OBJECTIVES:

- Understand the basic components and peripherals of a computer.
- To become familiar in configuring a system.
- Learn the usage of productivity tools.
- Acquire knowledge about the netiquette and cyber hygiene.
- Get hands on experience in trouble shooting a system?

1. System Assembling, Disassembling and identification of Parts / Peripherals

2. **Operating System Installation**-Install Operating Systems like Windows, Linux along with necessary Device

Drivers.

3. MS-Office / Open Office

a. **Word** - Formatting, Page Borders, Reviewing, Equations, symbols.
b. **Spread Sheet** - organize data, usage of formula, graphs, charts.
c. **Power point** - features of power point, guidelines for preparing an effective presentation.
d. **Access**- creation of database, validate data.

4. **Network Configuration & Software Installation**-Configuring TCP/IP, proxy and firewall settings. Installing application software, system software & tools.

5. **Internet and World Wide Web**-Search Engines, Types of search engines, netiquette, cyber hygiene.

6. Trouble Shooting-Hardware trouble shooting, Software trouble shooting.

7. **MATLAB-** basic commands, subroutines, graph plotting.

8. **LATEX**-basic formatting, handling equations and images.

OUTCOMES:

- Common understanding of concepts, patterns of decentralization implementation in Africa †
- Identified opportunities for coordinated policy responses, capacity building and implementation of best practices †
- Identified instruments for improved decentralization to the local level †
- Identified strategies for overcoming constraints to effective decentralization and sustainable management at different levels

TEXT BOOKS:

1. Computer Hardware, Installation, Interfacing, Troubleshooting and Maintenance, K.L. James, Eastern Economy Edition.
2. Microsoft Office 2007: Introductory Concepts and Techniques, Windows XP Edition ByGary B. Shelly, Misty E. Vermaat and Thomas J. Cashman (2007, Paperback).
3. LATEX- User's Guide and Reference manual, Leslie Lamport, Pearson, LPE, 2/e.
4. Getting Started with MATLAB: A Quick Introduction for Scientists and ngineers, Rudraprathap, Oxford University Press, 2002.
5. Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson, 2008
6. The Complete Computer upgrade and repair book, 3/e, Cheryl A Schmidt, Dreamtech.
7. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech.
8. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.

II Year – I Semester

L	T	P	C
4	0	0	3

PROBABILITY AND STATISTICS
(Common to Civil, CSE, IT, PE and PCE, Metallurgical Engineering)

Course Objectives: To acquaint students with the fundamental concepts of probability and statistics and to develop an understanding of the role of statistics in engineering. Also to introduce numerical techniques to solve the real world applications.

Course Outcomes: At the end of the Course, Student will be able to:

1. Examine, analyze, and compare various Probability distributions for both discrete and continuous random variables.
2. Describe and compute confidence intervals for the mean of a population.
3. Describe and compute confidence intervals for the proportion and the variance of a population and test the hypothesis concerning mean, proportion and variance and perform ANOVA test.
4. Fit a curve to the numerical data.

UNIT I: Discrete Random variables and Distributions:
Introduction-Random variables- Discrete Random variable-Distribution function-Expectation-Moment Generating function-Moments and properties.
Discrete distributions: Binomial, Poisson and Geometric distributions and their fitting to data.

UNIT II: Continuous Random variable and distributions:
Introduction-Continuous Random variable-Distribution function- Expectation-Moment Generating function-Moments and properties.
Continuous distribution: Uniform, Exponential and Normal distributions, Normal approximation to Binomial distribution -Weibull, Gamma distribution.

UNIT III: Sampling Theory:
Introduction - Population and samples- Sampling distribution of means (σ known)-Central limit theorem- t-distribution- Sampling distribution of means (σ unknown)- Sampling distribution of variances -χ^2 and F-distributions- Point estimation- Maximum error of estimate - Interval estimation.

UNIT IV: Tests of Hypothesis:
Introduction –Hypothesis-Null and Alternative Hypothesis- Type I and Type II errors –Level of significance - One tail and two-tail tests- Tests concerning one mean and proportion, two means-Proportions and their differences- ANOVA for one-way and two-way classified data.

UNIT V: Curve fitting and Correlation:
Introduction - Fitting a straight line –Second degree curve-exponential curve-power curve by method of least squares-Goodness of fit.
Correlation and Regression – Properties.

UNIT VI: Statistical Quality Control Methods:
Introduction - Methods for preparing control charts – Problems using x-bar, p, R charts and attribute charts.

Text Books:

1. **Jay l.devore,** Probability and Statistics for Engineering and the Sciences.8th edition,Cengage.
2. **Richards A Johnson, Irvin Miller and Johnson E Freund**. Probability and Statistics for Engineering, 9th Edition,PHI.

Reference Books:

1. **Shron L.Myers, Keying Ye, Ronald E Walpole,** Probability and Statistics Engineers and the Scientists,8th Edition, Pearson 2007.
2. **William Menden Hall, Robert J. Bever and Barbara Bever**, Introduction to probability and statistics, Cengage learning.2009
3. **Sheldon, M. Rosss**, Introduction to probability and statistics Engineers and the Scientists, 4th edition, Academic Foundation,2011
4. **Johannes Ledolter and Robert V.Hogg**, Applied statistics for Engineers and Physical Scientists, 3rd Edition, Pearson,2010

II Year – I Semester

L	T	P	C
4	0	0	3

PHYSICAL METALLURGY

(Course Objective: It is an introductory course for the students of Metallurgical Engineering and the subject deals with the fundamental concepts about the various types of microscopes, crystsal structures, phase diagrams and their applications.)

UNIT – I

(Learning objective: To understand the theory, construction and working details of Metallurgical microscopes.)

Microscopy; Metallurgical Microscope, principles and construction, types of objectives and eyepieces, common defects of lenses, electron Microscope.

UNIT – II

(Learning objective: To understand the basic crystal structures of various materials which forms the basis for the subsequent study of properties of materials.)

Structure of Metals, Hume-Rothery's classification of metals, metallic bond-crystal structure of metals, coordination number, relationship between lattice parameter and atomic radius, packing factor and density calculations, interstitials, polymorphism, plane and directional indices, transformation of indices.

UNIT – III

(Learning objective: To understand the constitution and necessity of alloy formation. To study the associated Hume Rothery rules for the formation of alloys.)

Constitution of Alloys: Necessity of alloying; types of solid solutions, Hume-Rotherys rules. Intermediate alloy phases, electro-chemical compounds, size factor, compounds and electron phases.

UNIT – IV

(Learning objective: The chapter outlines the various experimental methods of construction of phase diagrams. The unit also outlines the solidification behavior of materials during cooling.)

Equilibrium Diagrams: Experimental methods for construction of equilibrium diagrams, Isomorphous alloy systems, eutectic and partial eutectic systems.

Solidification: Types of Nucleation, determination of the size of critical nucleus, equilibrium cooling and heating of alloys, lever rule, coring, miscibility gaps. Simple problems using lever rule.

UNIT – V

(Learning objective: The unit intended to describe various phase diagrams and phase transformations)

Transformation in solid state, allotropy, order-disorder transformation, eutectoid, peritectoid reactions and complex phase diagrams, relation between equilibrium diagrams and physical properties of alloys. Study of important binary phase diagrams like Fe-Fe_3 C, Cu-Zn, Cu-Sn, and Al-Cu.

UNIT – VI

(Learning objectives: To provide the detailed explanation of phase transformations in steels and to understand the importance of isothermal diagrams)

Phase transformations in steels pearlitic, martensitic and bainitic transformations cooling curves. Isothermal transformation diagrams, transformations on continuous cooling.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities with special focus on academically weak students) should be tested periodically in classes by giving problems with respect to Phase diagrams and others. Unit tests are to be conducted at the end of each unit).

Text Book:

1. Introduction to Physical Metallurgy – S.H. Avner- McGraw-Hill publishers
2. Physical Metallurgy – Viajyendra Singh, Standard Publishers Distributors, 2005

References:

1. Physical Metallurgy principles-Reed Hill – CENGAGE Learning Publishers
2. Engineering Physical Metallurgy and Heat Treatment – Y. Laktin.
3. Elements of Physical Metallurgy – A.Guy
4. Metallographic laboratory practice – Kehl
5. Principles of Physical Metallurgy – Smith. M.
6. Introduction to Metallurgy – A.H. Cottrell
7. Metallurgy for Engineers-Clark and varney.
8. Physical Foundations of Materials Science – G. Gottstein
9. The Science and Engineering of Materials – Askeland et. al.
10. Physical Metallurgy – William F Hasford – CRC Press
11. Callister's Mateials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley, 2015

II Year – I Semester

L	T	P	C
4	0	0	3

METALLURGICAL THERMODYNAMICS – I

Course Objective: To provide a comprehensive coverage of the laws of thermodynamics and their applications so as to prepare the student for professional practice.)

UNIT-I

(Learning Objectives: The student can understand the basic concepts of the properties of a system to help them to get a clear understanding of reversible and irreversible processes.)

Objectives and limitations to thermodynamics, concepts of system and state, heterogeneous and homogeneous systems, extensive and intensive properties of system, thermodynamic variables, thermodynamic equilibrium. Reversible and irreversible processes.

UNIT-II

(Learning Objectives: The student can understand a clear concept of enthalpy and internal energy. It also helps in understanding a classification of work. These basic concepts will make the student to understand systems concept of manufacturing processes. It helps the student to identify, formulate and solve engineering problems.)

First Law of thermodynamics: Nature of first law, relationship between heat and work, internal energy and the first law of thermodynamics, calculations of work, constant capacity, reversible adiabatic processes, reversible isothermal pressure or volume changes of an ideal gas, enthalpy change with temperature, Kirchoff's equation. Steady state and unsteady state flow analysis.

UNIT-III

(Learning Objectives: It makes the student to understand a comprehensive view of efficiency of cycles in relation with irreversible and irreversible processes. It helps the student to identify, formulate and solve engineering problems.)

Second law of thermodynamics: Efficiency of a cyclic process, Carnot cylce, carnot therom, second law of thermodynamics, concept of entropy, entropy and quantification of irreversibility, reversible processes.

UNIT-IV

(Learning Objectives: To understand the concepts of free energy and entropy. To understand the relationship between these functions and their applications in various thermodynamic processes. It helps the student to identify, formulate and solve engineering problems.)

Third law of thermodynamics: Background of third law deductions from third law, applications of third law, and other methods of obtaining ΔS^0 for a reaction. Free energy functions: Purposes of the new functions, definition of Helmholtz and Gibbs free energy change, meaning of thermodynamically possible process, determination of ΔG from thermal data useful relationships between free energies and other thermodynamic functions, Maxwell's equation and Gibbs-Helmholtz equation.

UNIT-V

(Learning Objectives: To know the concepts of activity and equilibrium constants. It helps the student to identify, formulate and solve engineering problems.)

Fugacity, activity and equilibrium constant: Concepts of fugacity, activity and equilibrium constant variation of the equilibrium constant with temperature, Tabular methods of recording thermodynamic data, sigma functions.

UNIT –VI

(Learning Objectives: To know the importance oc Clausius clapeyron equation and its applications. It helps the student to identify, formulate and solve engineering problems.)

Claussius – Clapeyron equation: Introduction, derivation of the Claussius – Clapeyron equation for single substance, Duhriges rule for the estimation of the vapour pressures of an element, Integration of Claussius – Clapeyron equation. Problems.

Text Book:

1. Introduction to the thermodynamics of materials 5th Edition– D.R. Gaskell – CRC Press
2. Principles of metallurgical thermodynamics- S. K. Bose and S.K. Roy, University Press 2014

References:

1. Thermodynamics of solids-R.S.Swalin
2. Physical chemistry of metals-L.S.Darken & Gurry
3. Physical Metallurgy Priniciples – RH Reed hill.
4. Thermodynamics An Engineering Approach – Cengel – McgrawHill – 7th Edition
5. Fundamentals of thermodynamics-Sonntag et al
6. An Introduction to thermodynamics-Y.V.C.Rao
7. Chemical and Metallurgical thermodynamics – Prasad Krishnakanth – New Age Publications
8. Text Book of Materials and Metallurgical Thermodynamics: Ahindra Ghosh (PHI)

II Year – I Semester

L	T	P	C
4	0	0	3

MECHANICS OF SOLIDS AND FLUIDS

Objective: The students completing this course are expected to understand the basic terms like stress, strain, poissons ratio…etc and different stresses induced in beams, thin cylinders, thick cylinders, columns. Further, the student shall be able to understand the shear stresses in circular shafts. Further, the students completing this course are expected to understand the basic terms like viscosity, shear stress, bulk modulus, vapour pressure, cavitation…etc and study the continuity, Euler, Bernoulli, momentum and energy equations. They should be able to determine the flow rate using various measuring devices. Further, the student shall be able to understand the boundary layer theory, its separation and control. Knowledge of fluid flow characteristics through various geometries and compressible fluid flow theory shall be imparted to the student.

UNIT – I

Objective: After studying this unit student will know the basic terms like stress, strain poissons ratio…etc and stresses in bars of varying cross sections, composite bars, thermal stress in members, stresses on inclined planes with analytical approach and graphical approach, strain energy under different loadings and also problem solving techniques.

SIMPLE STRESSES & STRAINS : Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT – II

Objective: After studying this unit student will know the construction of shear force diagrams and bending moment diagrams to the different loads for the different support arrangements and also problem solving techniques.

SHEAR FORCE AND BENDING MOMENT : Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – III

Objective: After studying this unit student will know the bending and shear stress induced in the beams which are made with different cross sections like rectangular, circular, triangular, I, T angle sections and also problem solving techniques.

FLEXURAL STRESSES : Theory of simple bending – Assumptions – Derivation of bending equation: M/ I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

THICK CYLINDERS: –lame's equation – cylinders subjected to inside & outside pressures – compound cylinders.

UNIT – IV

Objective: After studying this unit student will know the basic terms like Density, Specific weight, Specific gravity, viscosity, Vapour pressure. To evaluate the variation of pressure between the two pipes of a u tube mano meters, study the applications Buoyancy concepts submerged in air.

Fluid Properties And Fluid Statics: Density, Specific weight, Specific gravity, viscosity, Vapour pressure, compressibility, Pressure at a point, Pascal's law, pressure variation with temperature, density and attitude. Hydro static law, Piezometer, Simple and differential manometers, pressure gauges, total pressure and center of pressure – plane, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

UNIT – V

Objective: After studying this unit student will know the basic flows like stream line, path line, streak line, steam tube. Practical applications of a laminar flow and turbulent flow with their significance. Mathematical approach connecting with stream function and potential function.

Fluid Kinematics : Stream line, path line, streak line, stream tube, classification of flows, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, one, two and three dimensional flows – Continuity equation in 3D flow, stream function, velocity potential function.

UNIT – VI

Objective: After studying this unit student will know the surface force gravity force viscos force pressure force surface tension force …etc. Using a cylindrical fluid element acting a gravity and pressure forces to generate the Eulers equation with its fluid kinematic analysis. Describe the flow measurements using a ventury meter and orifice meter.

Fluid Dynamics : Surface and Body forces – Euler's and Bernoulli's equation derivation, Navierstokes equation (explanation only) Momentum equation - applications, vortex – Free and Forced. Forced vortex with free surface. Similitude and Flow Measurement – Similarly laws, distorted models. Flow through Venturimeter and Orificemeter,

Text Books:

1. Strength of materials by Bhavikatti, Lakshmi publications.
2. Fluid Mechanics Hydraulics and Hydraulics Machines, Modi & Seth, Standard publications, New Delhi.

References :

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol-III, by S.B.Junnarkar.
4. Strength of Materials by S.Timshenko
5. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman.
6. Fluid Mechanics – Frank in white Mc-Grawhill.
7. Fluid Mechanics - John – F.Dauglas, Pearson Educations publishers.
8. Fluid Mechanics & Hydraulic Machines - D. Ramadurgaiah, Newage Publishers.

II Year – I Semester

L	T	P	C
4	0	0	3

PRINCIPLES OF EXTRACTIVE METALLURGY

Course objective: The main scope and objective is to give an overall view on the fundamental aspects of metal extraction processes.

UNIT-I

(Learning objective: The unit aims to discuss unit processes during the metal extraction.)

Introduction: Classification of ores, advantages and disadvantages of unit processes in extractive metallurgy. Calcination.

UNIT-II

(Learning objective: Deals with different types of roasting processes)

Roasting: Types of roasting: Oxidizing, sulphatising and chloridizing. Simple equations/reaction. Roasting furnace: Multiple hearth roaster, flash roasting, fluidized bed roasting, blast roasting. Sintering and pelletisation

UNIT-III

(Learning objective: The unit outlines different reduction processes and also discusses the Ellingham diagrams)

Smelting, smelting furnaces and slags: Principles of reduction and matte smelting with examples. Reverberatory, BF and electric smelting. Flash smelting. Classification, properties importance of Ellingham diagrams for oxides and sulphides and ellinghams limitations.

UNIT-IV

(Learning objective: The main objective is to describe the principles of leaching and associated hydrometallurgy)

Hydrometallurgy: Advantages and disadvantages. Flowchart. Principles and types of leaching. Solution purification by ion and solvent exchange. Metal recovery from leach solution by cementation.

UNIT-V

(Learning objective: The main objective is to describe the principles of electrometallurgy and electrowinning)

Classification of electrometallurgy, advantages and disadvantages electrometallurgy. Electrolytic cell-Anodic and cathodic reactions. General discussions on the electrowinnig of metals.

UNIT-VI

(Learning objective: The main objective is to describe the methods of refining)

Principles of Refining: Fire refining. Distillation, liquation, electro-refining and zone refining.

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (with special focus on academically weak students) at the end of each unit).

Text Book:

1. Non-ferrous extractive metallurgy: H.S Ray, K.P. Abraham and R.Sreedhar
2. Principles of extractive metallurgy-Gosh and Ray – new Age Publishers

Reference Books:

1. Principles of Extractive Metallurgy – F. Habashi – CRC Press

II Year – I Semester

L	T	P	C
4	0	0	3

POLYMERS

Course objective: The main scope and objective is to obtain knowledge over the properties, production and applications of various polymeric materials

UNIT-I

(Learning objective: To obtain knowledge over the fundamentals of polymerization and methods of polymerization)

Introduction to polymers and plastics: Conception of polymers, formation of polymers, types of polymers reactions such as addition and condensation, Mechanism of polymerization - Thermoplastic and Thermosetting materials methods of polymerization.

UNIT –II

(Learning objective: To obtain knowledge over the polymeric structure, raw materials, fabrication and properties of plastics)

Polymeric structure, raw materials and properties: Classification of polymers, raw materials for polymers and their sources. Brief study of structure of polymers and properties. Glass transition temperature and its significance. Crystallinity of polymeric materials, effect of time, temperature, catalysts and solvents on polymer properties, molecular weight of polymers.

Compounding and fabrication of plastics, calendaring and casting.

UNIT – III

(Learning objective: To obtain knowledge over the importance and functions of additives used in polymers)

Functions of the following types of additives used in Polymers: 1. Fillers 2. Lubricants 3. Reinforcing agents 4. Plastricizers 5. Stabilizers 6. Antioxidants 7. Inhibitors 8. Promoters 9. Catalysts 10. Refarders 11. Limitators 12. Colorants 13. Cross-linking 14. Blowing agents 15. Photo degradiants 16. Bio-degradiants, laminated polymers.

UNIT- IV

(Learning objective: To study the production of various thermo plastic and thermo setting resins)

Thermoplastics: Methods of addition polymerization, raw materials, manufacturing methods, properties and uses of the following ethenoid polymers: Polyethene (LDPE and HDPE), Polypropylene, Poly Vinyl Chloride, Polystyrene, Expanded polystyrene, Polytetra fluorethylene.

Thermosetting resins: Introduction of thermosetting polymers, methods of condensation polymerizatin, raw materials, manufacturing method, properties and uses of Phenol- Formaldehyde resin, Urea-formaldehyde resins, alkyl resins.

UNIT – V

(Learning objective: To obtain knowledge over the raw materials required for synthesis of polymers and manufacturing techniques used)

Raw materials, manufacturing methods, properties and uses of the following plastics Acetals, Nylons, Polymethyl, Methocrylate (PMMA), Saturated polysters – PETP and PC, Cellulose acetate and viscose rayon.

UNIT – VI

(Learning objective: To study and obtain knowledge over various types of rubbers)

Introduction of natural rubbers and synthetic rubbers like Buna-S, Buna-N, Thiokol, Polyurethane rubber and Silicon rubber.

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (With a focus on academically weak students) at the end of each unit.)

Text Book

1. The elements of polymer science and engineering, Rudin A, Academic Press, 3rd edition, 2013
2. Introduction to polymers, R.J. Young and P. A. Lovell, CRC Press, 3rd edition , 2013

References

1. Polymers hand book, J, Brandrup and E. H. Emmergut Wiley-Interscience 4th edition, 1999
2. Material Science and Metallurgy for Engineers –V.D.Kodgire and S. V. Kodgire, Everest Publishers, 2011
3. Callister's Mateials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley, 2015

II Year – I Semester

L	T	P	C
0	0	3	2

PHYSICAL METALLURGY LAB

Learning objective: Design the sequence of operations in a logical order. Experiments are to be conducted taking the necessary precautions. The microstructures should be observed at various magnifications and the structure should be interpreted and conclusions should be presented.

LIST OF EXPERIMENTS

1. Preparation and study of Crystal models.
2. Study of: Specimen cutting machine Specimen mounting press Grinding and polishing equipment
3. Study of various Metallurgical Microscopes and use of leveling press
4. Metallographic preparation of ferrous specimens for Microscopic examination
5. Preparation of non-ferrous specimens for Metallographic examination
6. Preparation and Metallographic study of pure metals like Iron, Copper, Aluminium etc..
7. Measurement of lattice parameters of various crystal structures and calculation of packing factors and size of vacancies.
8. Identification of Microstructures of steels

Equipment:

1. Specimen Cutting Machine
2. Specimen Mounting Press
3. Belt Grinding Machine
4. Disc Polishing Machines
5. Metallurgical Microscopes
6. Specimen Leveller.
7. Image analyzer
8. Standard samples with their microstructures

II Year – I Semester

L	T	P	C
0	0	3	2

MECHANICS OF SOLIDS LAB

List of Experiments

1. Tension test: Determination of yield stress, UTS and Breaking stress
2. Tension test on simply supported beam
3. Tension test on cantilever beam
4. Bending test on simply supported beam
5. Bending test on cantilever beam
6. Torsion test
7. Spring test
8. Compression test on cube
9. Shear test
10. Use of electrical resistance strain gauges

II Year – II Semester

L	T	P	C
4	0	0	3

MINERAL PROCESSING

Course objective: The course presents the principles and methods of beneficiation of minerals from their ores. It covers the theory and working of various crushers, classifiers and other mineral beneficiation equipment to meet the industrial needs.

UNIT I

(Learning objective: To study the scope of ore dressing and to describe the various crushers used in ore dressing)

Scope and objective of ore dressing, Sampling of ores by different methods. Theory of liberation of minerals. Crushers: -Jaw, Gyratory, Cone, Rolls and toothed roll crushers.

UNIT II

(Learning objectives: To understand the theory, principle and working of various ball mills used for size reduction)

Types of grinding operations like batch and continuous dry and wet grinding, open circuit and closed circuit grinding. Girnding Mills: Ball mills, theory of ball mill operation, rod and tube mills. Comminution laws: - Rittinger's laws, Kick's law and Bond's law.

UNIT III

(Learning objective: To explain the theory and principles of various sizing techniques. It also describes the movement of solids in fluids by explaining the effect of various parameters on the movement of solids.)

Sizing: Study of laboratory sizing techniques and reporting of sizing data. Industrial sizing units: Types of screen surfaces. Grizzlies, trommels, vibrating and shaking screens. Movement of solids in fluids: Stokes and Newton's laws. Terminal velocity and its relation with size. Relation between time and velocity. Relation between distance traveled and velocity. Equal settling ratio, Free and hindered settling ratios. Quantifying concentrating operations: Ratio of concentration, recovery, selectivity index and economic recovery.

UNIT IV

(Learning objectives: To understand the principles and working of classifiers. The student should also understand various heavy media separation methods.)

Classification of classifiers, study of settling cones, rake classifier, spiral classifier and cyclones. Heavy media separation: Principles, flow chart, different media used. Heavy media separation using heavy liquids and heavy suspensions. Washability curves for easy, normal and difficult coal.

UNIT V

(Learning objectives: The basic concepts involved in jigging and tabling will be detailed to understand the working of various jigging machines and other equipment involved with tabling.)

Jigging: Theory of jigging. Jigging machines: hand jig, harz jig, denner jig baum jig, Hancock jig, James coal jig and halkyln jig. Design considerations in a jig. Tabling: -study of stratification on a table. Shaking tables, wilfley table. Humphrey's spiral classifier.

UNIT VI

(Learning objectives: To understand the principles and applications of flotation and other separation processes and to be get acquainted with the working of equipment used for floatation process.)

Flotation: Principles of flotation, Factors affecting flotation. Classification of collectors and frothers. Regulators factors affecting their efficiency. Flotation machines: -Pneumatic and mechanical flotation cells. Application of flotation process for Cu,Pb and Zn ores. Magnetic separation processes and electrostatic separation process.

(*Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.*

Text Book:

1. Principles of Mineral Dressing by A.M. Gaudin.

References:

1. Elements of Ore Dressing by A.F. Taggart
2. Mineral processing technology-.A. Wills
3. Ore dressing practies-S.K.Jain.

II Year – II Semester

L	T	P	C
4	0	0	3

IRON MAKING

(***Course objective:*** *The subject deals with preparation of various types of iron ores, agglomeration methods and operation of Blast Furnace)*

UNIT-I

(Learning Objectives: To know the availability and preparation of iron ores.)

Development of iron making: Bloomery-stacks-catalon,forge-stukofen-B.F- Occurrence and distribution of iron ores in India and in the world, Preparation of iron ores.

UNIT-II

(Learning Objectives: To understand various agglomeration techniques of iron ores and their importance)

Sintering: Principles, raw materials and DL.machine.Mecghanism of sintering.sintering bonds. Factors affecting sintering efficiency. Pelletisation: Theory of pellatisation, Water-particles system. Production of green pellets: disk and drum pelletisers, Induartion of pellets: Shaft, traveling grate.

UNIT-III

(Learning Objectives: Study of BF coke, BF gases and their cleaning.)

Blast furnace coke: Functions, properties and uses, BF profile and design considerations. Furnace lining. Furnace cooling system. Hoisting equipment.B.F. Stoves. BF gas cleaning system and gas uses.

UNIT-IV

(Learning Objectives: Study of Physical Chemistry of reduction of ores, and uses and properties of slags.)

Physical chemistry of reduction of iron ores: Physical and chemical factors affecting reduction of ores. Relevant CO/CO2 and H2/H2O diagram. Controls of C, Si, S, P in metals and slags.

Blast furnace slags: Its constitution. Effect of CaO, SiO2, Al2O3 and MgO on fluidity of slags. Uses of slags.

UNIT-V

(Learning Objective: To understand the design and operation of Blast Furnace, blast furnace irregularities and methods of increasing productivity)

Blast Furnace Operation: Blowing in, blowing out, fanning and draughting. BF irregularities and their control/remedies. Development of BF: HTP, humidification of blast. O2 enrichment, hot blast temperature, BF additives, and top charging systems.

UNIT-VI

(Learning Objective: BF Burden calculations and study of alternate routes of iron making including wrought iron.)

BF Burden calculations: Raceways parameters. Factors affecting it. Alternative routes of iron making: Electric pig iron smelting, low shaft and small shaft BF.Clssification of sponge iron making. HYL, Kiln Krupp-Renn, Midrex process. Production of wrought iron.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.

Text Book

Modern Iron making Dr. R.H. Tupkary

Reference Books

1. Blast furnace theory and practice Vol. 1 and 2 edited by Julius H. Strassburger.
2. Principles of blast furnace Iron Making A.K. Biswas.
3. Making, shaping and treating of steels by United Steel Corporation, Pittsburgh
4. Manufacture of Iron & steel Vol-I-G.R.Bashforth.

II Year – II Semester

L	T	P	C
4	0	0	3

FUELS, FURNACES AND REFRACTORIES

*(**Course objective:** The subject deals with various types of fuels, their origin, classification and their properties. It also deals with various types of furnaces, their working principle, the types of Refractories used in them and various types of temperature measuring instruments.)*

UNIT I

*(**Learning Objectives:** To study the origin, classification and analysis of industrial fuels.)*

Introduction to Fuels technology Classification of fuels Origin and classification of coal Analysis of Coal Proximate and ultimate analysis.

UNIT II

*(**Learning Objectives:** Manufacture and testing of metallurgical coke along with the properties are to be studied)*

Pulverized fuels Principle of Carbonization Manufacture of Metallurgical coke Properties of Metallurgical Coke Testing of Coke.

UNIT III

*(**Learning Objectives:** Study of fuel oil production and fuel gases production and their uses)*

Principles of production of fuel oils from crude. Manufacture, properties and uses of

a) Producer gas
b) Water gas Properties and uses of Blast furnace gas and coke oven gas; cleaning of Blast furnace gas.

UNIT IV

*(**Learning Objectives:** Study of heat transfer through various bodies. Solving problems pertaining to them. Study of different furnaces.)*

Steady State Heat Transfer: Importance of Heat transfer, conduction through plane, cylindrical, Spherical and compound walls,shape factor and effect of variable thermal conductivity

Furnaces: Characteristic features of vertical shaft furnaces, reverberatory furnaces,Arc and Induction furnaces.Tube and muffle type resistance furnaces,continuous furnaces. Sources of heat losses in furnaces and heat balance.

UNIT-V

*(**Learning Objectives:** To study various types of pyrometers used in industry.)*

Pyrometry: Thermo electric pyrometry- peltier and Thomas e.m.f's . Thermo-electric power of thermocouples. Required properties of thermocouples. Noble and base metal thermocouples. Thermo-pile. Measurement of e.m.f by Milli-voltmeters and potentiometers.Thermometer; optical and radiation pyrometer.

UNIT VI

***Learning Objectives:** To study different types of Refractories, their manufacturer, properties and industrial users.*

Refractories: Desirable properties of Refractories. Methods of classification. Modes of failure of refractories in service and their prevention.Manufacturing methods and properties of Fireclay, Silica Magnesite and Chrome-Refractories. Testing of Refractories. Applications of refractories in the metallurgical industries.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.

Text Book:

1. Furnaces, Fuels and Refractories by O.P.Gupta, Khanna Publishers.

References:

1. Elements of fuel technology -HIMUS
2. Refractories Norton
3. Refractories-R.Chisti.
4. Furances-J.D.Gilchrist
5. Pyrometry-W.P.wood& J.M.corck
6. Fuels Furnaces, Refractories& Pyrometry-A.V.K.Surya Narayana.
7. Elements of heat transfer- Jakob&Hawikns.
8. Elements of thermodynamics& heat transfer- Obert & Young.
9. Control systems & Instrumentation S.Bhasker.

II Year – II Semester

L	T	P	C
4	0	0	3

METALLURGICAL THERMODYNAMICS - II

(Course Objective: To apply knowledge of maths, science and Engineering to understand the application of the thermodynamics for diffusion, thermal properties, solutions, phase diagrams and reversible cell studies. To study the kinetics of chemical processes)

UNIT-I

(Learning objective: To understand the basic concepts of diffusion with a detailed theoretical and experimental study of diffusion mechanisms in metals and alloys.)

Diffusion: Ficks law of diffusion and its application, Kirkendal effect. Darken's equation, the Metano method, Determination of intrinsic diffusivities, Self-diffusion in pure metals, diffusion along the grain boundaries and surfaces. Problems.

UNIT-II

(Learning objective: To understand the importance of Ellingham diagrams in metal extraction processes.)

Ellingham diagrams: Introduction, calculation of equilibrium constants from standard free energy changes, general description of Ellingham diagrams, Interpretation of two or more free energy change Vs. temperature lines taken together, derivation and uses of the oxygen, nomographic scale in Richardsons diagrams.

UNIT – III

(Learning objective: To understand the modes of heat transfer)

Modes of heat transfer, conduction, convection and radiation. Heat flow through composite walls.

UNIT-IV

(Learning objective: To apply thermodynamic concepts for the study of phase diagrams.)

Application to phase diagrams: concept of chemical potential, equality of chemical potentials in equilibrated phases derivation of Gibb's phase rule, solidus and liquidus lines for an ideal solution, calculation of liquidus line for eutectic systems

UNIT-V

(Learning objective: To understand the application of thermodynamics for the study of electro chemical cells)

Reversible cells: Electro-Chemical cells, galvanic cells, chemical and electrical energy, thermodynamics of electro-chemical cells, standard electrode epotentials, sign convention of electrode potentials, application of Gibbs- Helmhoitz equation to galvanic cells. Concetration Cells.

UNIT-VI

(Learning Objectives: To understand the kinetics of chemical processes and simultaneous reactions. It helps the student to identify, formulate and solve engineering problems.)

Kinetics: Kinetics of chemical process, Molecularity and order of a reaction, zero order reactions, first order, second order reactions, Determination of order of reaction, collision theory, theory of absolute reaction rates, consecutives and simultaneous reactions, catalysis in chemical reactions.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. Physical chemistry of Metals-LS Darken and Gurry
2. Phase transformations in metals and alloys- D. A. Porter, K. E. Easterling and M. Sherif, CRC Press, 3rd edition, 2009

Reference Books:

1. Problems in metallurgical thermodynamics and kinetics- G. S. Upadhyaya and R. K. Dube, Pergamon Press, 1st edition, 1977
2. Thermodynamics of Solids RA Swalin
3. Physical Metallurgy Principles-RH Reed Hill
4. Material science and Engineering: A First course-V. Raghavan, PHI Learning, 6th edition, 2015

II Year – II Semester

L	T	P	C
4	0	0	3

NON FERROUS EXTRACTIVE METALLURGY

*(**Course objective:** The subject deals with the ores and extraction of Copper, Lead, Aluminium, Magnesium, Uranium Titanium etc.)*

UNIT I

*(**Learning Objective:** Study of Extraction of copper from minerals to electro winning.)*

COPPER: Principal Ore and Minerals; Matte smelting – Blast furnace, Reverberatory, Electric furnace, Flash; Converting; Continuous production of blister Copper; Fire refining; Electrolytic refining; Hydro-Metallurgical copper extraction; Leaching processes, Recovery of copper from leach solutions; Electro-winning.

UNIT II

*(**Learning Objective:** Study of Extraction of lead and Zinc.)*

ZINC: General Principles: Horizontal and vertical retort processes: Production in a Blast furnace: Leaching purification: Electrolysis, Refining. **LEAD:** Blast furnace smelting, Refining of lead bullion

UNIT III

*(**Learning Objective:** Study of Extraction of Aluminium by different processes)*

ALUMINIUM: Bayer process, Hall - Heroult process, Anode effect: Efficiency of the process, Refining, Alternative processes of aluminium production.

UNIT IV

*(**Learning Objective:** Extraction of light metals like megnishium and titanium from various sources and methods)*

MAGNESIUM: Production of a hydrous Magnesium chloride from sea water and magnesite. Electro-winning practice and problem, refining, Pidgeon and Hansgrig processes.

TITANIUM: Upgrading of ilmenite, chlorination of titania, Kroll's process. Refining.

UNIT V

*(**Learning Objective:** Purification of Uranium ore and production of reactor grade UO2 and U.)*

URANIUM: Acid and alkali processes for digestion of uranium ores, Purification of crude salt, Production of reactor grade UO2 and uranium.

UNIT VI

*(**Learning Objective:** Study of simplified flow sheets of various metals and review of NF Industry in India)*

Simplified flow sheets for the extraction of nickel, tungsten and gold. Review of non-ferrous metal industries in India.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.

Text Books

1. Extraction of Non-Ferrous Metals - HS Ray, KP Abraham and R. Sridhar
2. Metallurgy of Non-Ferrous Metals - WH Dennis

References

1. Rare Metals Hand book - C.A. Hampel
2. Nuclear Reacto General Metallurgy - N. Sevryukov, B. Kuzmin and Y. helishchevr
3. Engineering - S. Glass Stone and A. Sesonske.
4. Nuclear Chemical Engineering - Manstion Bendict and Thomas H. Pigfort

II Year – II Semester

L	T	P	C
4	0	0	3

ALTERNATIVE SOURCES OF ENERGY

UNIT-I

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems.

UNIT-II

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT-III

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT-IV

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

UNIT-V

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

UNIT-VI

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential in India.

UNIT-VII

OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT-VIII

DIRECT ENERGY CONVERSION : Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, See-beck, Peltier and Joul Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions, photo voltaic energy conversion – types of PV cells, I-V characteristics.

Text Books:

1. Sukhatme S.P. and J.K.Nayak, *Solar Energy – Principles of Thermal Collection and Storage*, TMH
2. Khan B.H., Non-Conventional Energy Resources, Tata McGraw Hill, New Delhi, 2006

References:

1. Solar Power Engineering / B.S Magal Frank Kreith & J.F Kreith.
2. Principles of Solar Energy / Frank Krieth & John F Kreider.
3. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa

II Year – II Semester

L	T	P	C
0	0	3	2

MINERAL PROCESSING LAB

(Learning objective: Design the sequence of operations in a logical order. The relevant tabular forms are to be prepared. Experiments are to be conducted taking the necessary precautions. The data should be recorded and the results need to be interpreted using the necessary mathematical expressions. The graphs are to be drawn where ever required and the appropriate conclusions should be presented.)

List of Experiments

1. Sampling of an ore from the bulk by
   i) Coning and quartering method
   ii) Riffle sampler methods
2. Sizing by Sieve analysis of crushed ore
3. Verification of Stoke's Law.
4. Determining the reduction ratio of a jaw crusher.
5. Study of the variation of reduction ratio with process variables in Rolls crusher.
6. Study of the process variables on reduction ratio and particle size distribution in ball mill.
7. To find the grindability index of ores.
8. Verification of Laws of Communution.
9. Determination of the efficiency of a magnetic separator.
10. Determination of the efficiency of a jig.
11. Study of the particle separation by fluid flow using wilfley table.
12. Determination of the efficiency of a pneumatic separator.
13. To study the concentration of metallic and non-metallic ores by Froth-Flotation process.

Equipment:

1. Riffle Sampler
2. Sieve Shakar with Sieves
3. Stokes' Apparatus
4. Jaw Crusher
5. Roll Crusher
6. Ball Mill
7. Grindability Index Apparatus
8. Magnetic Seperator
9. Jig
10. Wilfly's Table
11. Pneumatic Seperator
12. Froth – Floatation Equipment
13. Balances

II Year – II Semester

L	T	P	C
0	0	3	2

FUELS AND METALLURGICAL ANALYSIS LAB

(Learning objective: Design the sequence of operations in a logical order. The relevant tabular forms are to be prepared. Experiments are to be conducted taking the necessary precautions. The data should be recorded and the results need to be interpreted using the necessary mathematical expressions. The graphs are to be drawn where ever required and the appropriate conclusions should be presented)

LIST OF EXPERIMENTS:

1. To conduct proximate analysis of Coal
2. To conduct ultimate analysis of Coal
3. To find the Flash and Fire points of fuel oil by "PENSKY MARTINS" and ABEL'S apparatus.
4. To find the viscosity of lubricant oil by using
   a. Red-wood-I Viscometer
   b. Red-wood-II Viscometer
   c. Saybolt Viscometer
5. Estimation of Silicon and Manganese in Cast Iron.
6. Estimation of Carbon in Steel by Strohlein apparatus method.
7. Estimation of Copper in Brass by Electrolytic method.
8. Estimation of Chromium, in Steel.
9. Estimation of the concentration of KMnO**4** in the solution using Digital Spectrophotometer.
10. Estimation of Sulphur and Phosphorus in cast irons and in stainless steels

EQUIPMENT:

1. C & S Strohlein apparatus
2. Digital Spectrophotometer
3. Electronic digital balances – 2 No's
4. Muffle Furnace (1000^0 c) – 2 No's
5. Pensky Martins Apparatus
6. Abels Flash Point Apparatus
7. Red – wood – I Viscometer
8. Red – wood – II Viscometer
9. Say bolt Viscometer
10. Digital Electronic Balance

(Assessment: The student's performance should be evaluated at the end of each lab session based on the following parameters:

1. observation book,
2. Record.
3. Conduct of the experiment successfully
4. Interpretation of the data
5. Drawing the graphs where ever necessary
6. Viva-voce.

III Year – I Semester

L	T	P	C
4	0	0	3

FOUNDRY TECHNOLOGY

Course objective: *The course deals with various types of Foundries, patterns, moulding materials and different types of casting methods including modern methods.*

UNIT I

Learning Objectives: *To know about various types of foundries and know the patterns and moulding sands and additives used for getting good molds.*

Scope and development of Foundry. Types of foundries. PATTERNS: Materials for patterns, types of patterns; functions and pattern allowance. MOULDING MATERIALS: Moulding sands, properties and selection of materials and additives used.

UNIT II

Learning Objectives: *To know indetail about various casting processes and properties in molds. Gating and risering in molds.*

CASTING PROCESSES AND EQUIPMENT: Green and dry sand moulding; shell moulding, CO2 moulding. Core moulds and cores. Plaster mould casting, composite mould casting, Investment casting.

GATING AND RISERING: Gate nomenclature, gate types and types of risers.

UNIT III

Learning Objectives: *Study of different molding processes and their equipment*

Permanent mould casting, pressure die-casting, Gravity die-casting and centrifugal casting, Types of moulding equipment.

UNIT IV

Learning Objectives: *Solidification of metals and alloys and melting practices to be studied*

SOLIDIFICATION OF METALS: Nucleation crystal growth. Freezing of metals and alloys. Dendritic freezing. Coring and segregation, ingot defects, Flow of metals in moulds.

MELTING OF FERROUS ALLOYS: 'Melting of Gray iron and cupola. Cupola operation and control. Effect on chemical composition, carbon equivalent and effect of alloying elements on foundry characteristics. Melting of non-ferrous alloys: Melting of Aluminium and copper alloys production processes: Production of Gray Iron, ductile iron. Malleable iron castings

UNIT V

Learning Objectives: *Various casting defects and their prevention to be studied*

CASTING DEFECTS: Casting defects arising due to moulding, coring melting and poring practice.

UNITI VI

Learning Objectives: *Study of modern molding processes to be studied*

MODERN DEVELOPMENTS: Recently developed processes - v- forming full mould process - Furon-no-bake sand moulds and cores. Continuous casting. Cold setting and self-setting processes

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.

Text Books

1. Principles of Metal casting by Heine, Loper and Rosenthal.
2. Foundry Technology – Dhuvendra kumar & S.K.Jain

Reference Books

1. Metals Handbook Vol. 5 published by ASM, Ohio.
2. Foundry Technology-Jain
3. Foundry Technology Principles-T.V.Ramana Rao

III Year – I Semester

L	T	P	C
4	0	0	3

STEEL MAKING

Course Objective: *This subject deals with various methods of steel making and construction details of various types of furnaces used for steel making.*

UNIT-I

Learning Objective: *To understand about various types of raw materials used for steel making and about various early steel making processes.*

Classification of Steel making Processes. Early steel making processes: Cementation and crucible processes. Raw materials for steel making. Factors affecting efficiency of steel making.

UNIT-II

Learning Objective: *It throws some light on principles of Decarburization, Dephosphorisation and deoxidation.*

Principles of Steel making, Decarburisation, desiliconization. Dephosphorisation and desulphurisation. Principles of deoxidation. Types of deoxidation:-Precipitation, diffusion and treatment with syethethic slags,molecular and ionic theory of slags.

UNIT-III

Learning Objective: *To understand steel making process by Bessemer convertor.*

Construction and process details in acid and basic Bessemer convertors and openhearth furnance. Improvement and modification of the above process.

UNIT-IV

Learning Objective: To *understand the principles of steel making by modern methods.*

Construction and process details in LD, LD-AC, Kaldo and rotor steel making processes. Bottom blown O2 processes. Combined blow processes. Continuous steel making process: - BISRA, IRSID & WORCRA Process. Construction details of electric arc furnace; production of steel. Induction furnance for steel making

UNIT-V

Learning Objective: *To understand the principles of Solidification of steels and various Ingot defects.*

Teeming Practices: - Direct, bottom and uphill Teeming methods. Casting pit side practice. Solidification of steels. Ingot defects and remedies; secondary steel making processes.Vacuum treatment of steels

UNIT-VI

Learning Objective: *To understand about Continuous casting of steels.*

Continuous casting of steels. Electro slag refining process. Vacuum arc remelting process. Brief outline of manufacture of alloy steels.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.

Text Books

1. Modern Steelmaking – Dr. R.H. Tupkary and V.H. Tupkary

References

1. Making Shaping and Treating of Steels by United States Steel Corporation, Pittsburgh.
2. Open Hearth furnace practice - Bornatsky,
3. Manufacture of Iron and Steel, Vol. II by Gr Bashforth
4. Steel Making: A. K. Chakrabarthi (PHI)

III Year – I Semester

L	T	P	C
4	0	0	3

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS
(Common to all Branches)

Course Objectives:

- The Learning objectives of this paper is to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting, Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis.
- To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles.
- To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation. Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

UNIT-I

Introduction to Managerial Economics and demand Analysis:

Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

UNIT – II

Production and Cost Analyses:

Concept of Production function- Cobb-Douglas Production function- Leontief production function - Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit analysis-Determination of Breakeven point(simple problems)-Managerial significance and limitations of Breakeven point.

UNIT – III

Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing.

UNIT – IV

Types of Business Organization and Business Cycles:

Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms – Business Cycles : Meaning and Features – Phases of a Business Cycle.

UNIT – V

Introduction to Accounting & Financing Analysis:

Introduction to Double Entry Systems – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow statements (Simple Problems)

UNIT – VI

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

Course Outcome:

*The Learner is equipped with the knowledge of estimating the Demand and demand elasticities for a product and the knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.

* One is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.

*The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis and to evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

Text Books

1. Dr. N. AppaRao, Dr. P. Vijay Kumar: 'Managerial Economics and Financial Analysis', Cengage Publications, New Delhi – 2011
2. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011
3. Prof. J.V.Prabhakararao, Prof. P. Venkatarao. 'Managerial Economics and Financial Analysis', Ravindra Publication.

References:

1. Dr. B. Kuberudu and Dr. T. V. Ramana: Managerial Economics & Financial Analysis, Himalaya Publishing House, 2014.
2. V. Maheswari: Managerial Economics, Sultan Chand.2014
3. Suma Damodaran: Managerial Economics, Oxford 2011.
4. VanithaAgarwal: Managerial Economics, Pearson Publications 2011.
5. Sanjay Dhameja: Financial Accounting for Managers, Pearson.
6. Maheswari: Financial Accounting, Vikas Publications.
7. S. A. Siddiqui& A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2012
8. Ramesh Singh, Indian Economy, 7th Edn., TMH2015
9. Pankaj Tandon A Text Book of Microeconomic Theory, Sage Publishers, 2015
10. Shailaja Gajjala and Usha Munipalle, Univerties press, 2015

III Year – I Semester

L	T	P	C
4	0	0	3

PHASE TRANSFORMATIONS AND HEAT TREATMENT

Course Objective: *This subject deals with Principles of heat treatment of steels, Alloy steels and some non ferrous alloys and different heat treatment methods.*

UNIT-I

Learning Objective: *This unit deals with principles of heat treatment, and different hardenability methods.*

Principles Of Heat Treatment: Austenitic Transformation, Pearlitic Transformation, Bainitic Transformation, Martensitic Transformation, Annealing, Normalizing, Hardening, mechanism of heat removal during quenching, quenching media, size and mass effect, hardenability, tempering, austempering, manufacturing, deep freezing. Heat treatment furnaces and their design, atmosphere control vacuum heat treatment etc

UNIT-II

Learning Objective: *To learn about different surface hardening methods.*

Surface heat treatment, carburizing, cyaniding, flame and induction hardening, residual stresses, deep freezing, thermo mechanical treatments: HTMT, LTMT, Ausforming, Isoforming, Cryoformy.

UNIT-III

Learning Objective: *This topic throws light on TTT Curves and effect of alloying elements on Fe-Fe_3C system.*

Effect Of Alloy Elements: Purpose of alloying, effect of alloying elements on ferrite, cementite, Fe-Fe_3C system, tempering and TTT Curves.

UNIT-IV

Learning Objective: *This topic explain heat treatment of various types of tool and die steels.*

Alloy Steels: Structural and constructional steels, maraging steels, tool and die steels. Corrosion and heat resistant steels, Hadfield steels, magnetic steels and alloys, free machining steels.

UNIT-V

Learning Objective: *To understand the principles of heat treatment of various cast irons.*

Cast Irons: White cast iron, grey cast iron, spheroidal graphite iron, malleable cast iron, alloy cast iron.

UNIT-VI

Learning Objective: *To understand the principles of heat treatment of various non ferrous alloys.*

Non-Ferrous Metals And Alloys: Precipitation hardening, aging treatment, study of copper and its alloys, aluminum and its alloys, nickel and its alloys.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.

Text Books

1. Heat Treatment Principle and Techniques-Rajan & Sharma
2. Heat treatment of metals- Vijayendra Singh, 2nd edition, Standard Publishers Distributors, 2006

References

1. Heat Treatment of metals-Zakharv-Mir Publishers
2. Physical Metallurgy Lakhtin-Mir Publishers
3. Physical Metallurgy - Clark and Varney
4. Physical Metallurgy Principles - Reed Hill
5. Physical metallurgy-Raghavan
6. Mateials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley, 2015

III Year – I Semester

L	T	P	C
4	0	0	3

MATERIAL TESTING AND EVALUATION

Course Objective: *This subject deals with defects in materials, various hardness methods, fatigue and impact tests.*

UNIT- I

Learning Objective: *The topic deals with various types of dislocations, slip and twinning*.

Metallurgical Fundamentals: Critical resolved shear stress. Defects in crystalline materials Point defects and line defects. The concept of dislocation - Edge dislocation and screw dislocation. Interaction between dislocations, sessile dislocation, glissile dislocation, Energy of a dislocation, dislocation climb, Jogs, Forces on dislocations. Frank Reed source, slip and twinning.

UNIT- II

Learning Objective: *To understand the principles of various hardness tests and theories of fracture.*

Hardness Test: Methods of hardness testing Brinell, Vickers, Rockwell, Rockwell superficial, Shore and Poldi methods, Microhardness test, relationship between hardness and other mechanical properties. Fracture: Elementary theories of fracture, Griffiths theory of brittle fracture, Ductile Fracture, Notch sensitivity.

UNIT III

Learning Objective: *To understand the principle of tensile test, compression Test etc.*

The Tension Test: Mechanism of elastic action, linear elastic properties. Engineering stressstrain and True stress-strain curve. Tensile properties, conditions for necking, effect of temperature and strain rate on tensile properties. The Compression Test: Elastic and in-elastic action in compression, elastic and in-elastic properties in compression. compression Test

UNIT IV

Learning Objective: *To understand about transition temperature and the factors that affect transition temperature.*

The Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, fracture toughness testing - COD and CTOD tests, significance of transition temperature curve, Metallurgical factors affecting on transition temperature, temper embrittlement.

UNIT- V

Learning Objective: *To know the fundamentals, failure and the factors affecting fatigue and creep.*

Fatigue and Creep Tests: Introduction, Stress cycles, S-N Curve, Effect of mean stress, Mechanism of fatigue failure, effect of stress concentration, size, surface condition and environments on fatigue. Effect of metallurgical variables on fatigue. Low cycle fatigue - High cycle fatigue.

Creep, creep curve, Stress-rupture test, Structural changes during creep, Mechanism of creep deformation, theories of creep. Fracture at elevated temperature, Effect of Metallurgical variables on creep.

UNIT- VI

Learning Objective: *To know the non-destructive testing methods and evaluation of flaws in materials*

NDT: Introduction, Dye penetrant test, Magnetic particle test, Ultrasonic flaw detection method, Radiography and Eddy current test. Testing methods, applications advantages of one test over the other.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.

Text Books

1. Mechanical Metallurgy - GE Dieter

References

1. Engineering Materials Science - CW Richards
2. Mechanical behavior of material-A.H.Courteny
3. Mechanical behavior-Ed.Wulf.
4. Mechanical Metallurgy White & LeMay.

III Year – I Semester

L	T	P	C
0	0	3	2

FOUNDRY TECHNOLOGY LAB

(Learning objective: Design the sequence of operations in a logical order. The relevant tabular forms are to be prepared. Experiments are to be conducted taking the necessary precautions. The data should be recorded and the results need to be interpreted using the necessary mathematical expressions. The graphs are to be drawn where ever required and the appropriate conclusions should be presented.)

LIST OF EXPERIMENTS:

1. Preparation of gating system using green sand.
2. Study of particle size distribution of the sand.
3. Study of the variation of permeability of the green sand with clay and water.
4. Determination of the variation of sand properties like green hardness, green compact strength with additives in sands.
5. Determination of the variation of hot compact hardness and hot shear strength with additives in sands.
6. Determination of clay content in sand.
7. Determination of the shatter index of green sand.
8. Founding of Al and Cu alloys in a pit furnace and casting into light components.
9. Study Charge calculations and melting practice of cast iron in a cupola.
10. Preparation of a shell-by-shell moulding process.
11. Non-destructive testing of a few cast iron components.

Equipment:

1. Mould Boxes, Patterns, Cove Boxes, Tool Boxes.
2. Rotap Sieve Shaker with Sieves
3. Permeability Apparatus.
4. Universal Sand testing Machine with Accessories.
5. Sand Hardness tester.
6. Clay Content Apparatus
7. Shatter Index test.
8. For Melting : Pit Furnace, Electric Furnace
9. Shell Moulding Machine
10. Centrifugal Casting Machine
11. Ultra Sonic Tester
12. Ladles, Crucibles and other Accessories
13. Muffle Furnace 1000^0c

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

II.

1. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

III Year – I Semester

L	T	P	C
0	0	3	2

HEAT TREATMENT LAB

Learning objective: Design the sequence of operations in a logical order. The relevant tabular forms are to be prepared. Experiments are to be conducted taking the necessary precautions. The data should be recorded and the results need to be interpreted using the necessary mathematical expressions. The graphs are to be drawn where ever required and the appropriate conclusions should be presented.

List of Experiments:

1. Annealing of medium carbon steel and observation of microstructure.
2. Normalizing of medium carbon steel and observation of microstructure.
3. Hardening of medium carbon steel and observation of microstructure.
4. Study of tempering characteristics of water quenched steel.
5. Study of age hardening phenomena in duralumin.
6. Spheroidizing of a given high carbon steel.
7. Determination of hardenability of medium carbon steel by Jominy end Quench Test.
8. To conduct Re-crystalization studies on cold worked copper.

Equipment:

1. Muffle Furnaces 1000^0c – 2 No's
2. Muffle Furnaces 300^0c – 2 No's
3. Muffle Furnaces 120^0c – 1 No's
4. Hardenability Apparatus
5. Micro Scopes
6. Vickers Hardness Tester

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

II.

1. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

III Year – I Semester

L	T	P	C
0	0	3	2

MATERIAL TESTING AND EVALUATION LAB

Learning objective: Design the sequence of operations in a logical order. The relevant tabular forms are to be prepared. Experiments are to be conducted taking the necessary precautions. The data should be recorded and the results need to be interpreted using the necessary mathematical expressions. The graphs are to be drawn where ever required and the appropriate conclusions should be presented.

List of Experiments:

1. Hardness Test: to determine the Brinell Hardness Values of values of ferrous and non-ferrous samples.
2. Tension Test: - To determine the elastic modulus, ultimate tensile strength, breaking stress, percentage elongation and percentage reduction in area of the given specimen. - To determine the strain distribution along the gauge length.
3. Torsion Test: -To determine the modulus of rigidity of given material.
4. Impact Testing: - To determine the charpy and Izod (V & U Groove notch) values of a given material at room temperature. - To establish the ductile - brittle transition temperature of the material.
5. Fatigue Test: - To determine the number of cycles to failure of a given material at a given stress.
6. To determine the Rockwell hardness values of heat treated steels.
7. To find the microhardness of phases by using vickers hardness tester.
8. Non-destructive tests: Dye penetrant, Ultrasonic, Magnetic particle.
9. To Conduct Erichson cupping test.
10. To conduct creep experiment

Equipment:

1. Brinell Hardness Machine
2. Vickers Hardness Machine
3. Rockwell Hardness Machine
4. UTM
5. Torsion Testing Machine
6. Impact Testing Machine
7. Fatigue Test Machine
8. Erichson Cupping Test
9. Magnetic particle, dye penetrant and ultrasonic testing equipment
10. Creep testing Machine

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

II.

1. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

III Year - I Semester

L	T	P	C
0	2	0	0

INTELLECTUAL PROPERTY RIGHTS AND PATENTS

Objectives:

***To know the importance of Intellectual property rights, which plays a vital role in advanced Technical and Scientific disciplines.**

***Imparting IPR protections and regulations for further advancement, so that the students can familiarize with the latest developments.**

Unit I: Introduction to Intellectual Property Rights (IPR)

Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

Unit II: Copyrights and Neighboring Rights

Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers **–** Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act.

UNIT III: Patents

Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations.

UNIT IV: Trademarks

Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities - Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

UNIT V: Trade Secrets

Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets - Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law.

UNIT VI: Cyber Law and Cyber Crime

Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions - E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers.

- Relevant Cases Shall be dealt where ever necessary.

Outcome:

*** IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents.**

***Student get an insight on Copyrights, Patents and Software patents which are instrumental for further advancements.**

References:

1. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
2. Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.
3. PrabhuddhaGanguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
4. Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
5. Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).
6. Cyber Law - Texts & Cases, South-Western's Special Topics Collections.
7. R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.
8. M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

III Year –II Semester

L	T	P	C
4	0	0	3

METERIALS JOINING TECHNIQUES

*(**Course Objective:** This subject deals with various methods of welding of various materials like steels, stainless steels, Copper. It also deals with methods of soldering and brazing and different welding defects.)*

UNIT I

Learning Objective: *The topic deals with the principle of welding and heat affected zone*

The principles and theory, mechanism and key variables of different welding processes, types of tooling and equipment. Microstructure of fusion and heat affected zone, welding stresses, pre and post treatments.

UNIT-II

Learning Objective: *To know the advantages and disadvantages of different types of welding processes.*

Advantages, disadvantages and field of application of the welding with reference to the following welding processes, Gas welding, Arc welding, submerged arc welding, TIG, MIG, Plasma arc welding.

UNIT III

Learning Objective: *To understand latest methods of welding.*

Electron Beam welding (including EMPOR) spot-welding, Laser welding, diffusion welding.

UNIT-IV

Learning Objective: *The topic throws some light on welding of stainless steels and their welding defects.*

Welding of structural steel, welding of cast iron, welding of stainless steel and other high-alloyed steels. Welding defects and remedies

UNIT-V

Learning Objective: *To understand the welding of Aluminum and Copper and their alloys.*

Welding of copper and its alloys, welding of aluminum and its alloys, joining of dissimilar alloys.

UNIT VI

Learning Objective: *Principles of Soldering and Brazing can be studied in this Unit.*

Mechanism, Techniques and scope of brazing, soldering and adhesive bonding processes.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.

Text Books

1. Welding Technology-R.S.Parmar**.**

References

1. JF Lancaster: Welding Metallurgy
2. Little: Welding and Welding Technology
3. Agarwal Manghmani: Welding Engineering
4. BE Rossi: Welding Engineering

III Year –II Semester

L	T	P	C
4	0	0	3

INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Objective:

***To impart knowledge on scientific principles of management to improve productivity in manufacturing Industry.**

***To impart knowledge on fundamentals of functional management to improve performance in industry.**

UNIT – I

Introduction: Definition of Industrial Engineering, Development, Applications, Role of an industrial engineer, Quantitative tools of IE and productivity measurement, Concepts of Management, Importance, Functions of management, Scientific management, Taylor's principles, theory X and theory Y, Fayal's principles of management.

UNIT-II

Functional Management: Nature and importance of management-Concept of HRM ,and HRD - Functions of HR Manager- Financial management: concept, meaning and functions of Financial management, Capital budgeting - Marketing Management- Functions, strategies, Channels of distributions.

UNIT – III

Operations Management: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

UNIT – IV

Plant layout: Definition, types and principles of plant layouts.-Statistical Quality Control: Control charts and its applications-*X* and S charts and their applications, numerical examples.

UNIT – V

Human Resource management: Concept and functions of Human Resource Management, Industrial relations, Job-evaluation and merit rating, wage and salary administration.
Value analysis: value engineering, implementation procedure.

UNIT – VI

Project management: PERT, CPM – differences & applications, Critical path, determination of floats, importance, project crashing, smoothing and numerical examples.

Course Outcome:

***After completion of the course the student will familiarize with the fundamentals, basic tools of Operations Management, Statistical quality control Techniques, and the fundamental principles of project management,**

***The student will familiarize with concepts of management, functional management, Wage and Salary administration.**

Text Books:

1. Industrial Engineering and Management by O.P Khanna, Khanna Publishers.
2. Industrial Engineering and Production Management, Martand Telsang, S.Chand & Company Ltd. New Delhi

Reference Books:

1. Operations Management by J.G Monks, McGrawHill Publishers.
2. Production and Operations Management – R.Panneerselvam- PHI- 3rd Edition
3. Industrial Engineering by Banga & Sharma.
4. Principles of Management by Koontz O' Donnel, McGraw Hill Publishers.
5. PERT/CPM by L.S Srinath, East west Press.
6. Production and operations management by K.C Arora.
7. Statistical Quality Control by Gupta.
8. Manufacturing Organization and Management, Harold T. Amrine, John A. Ritchey, Colin L. Moodie & Joseph F. Kmec, Pearson
9. Essentials of HRM and IR: P.Subba Rao, Himalaya Publishing House, Hyderabad, 2015.
10. Introduction to Management Science: Kumar, Rao, Chhalill, Cengage Learning, New Delhi, 2012.

III Year – II Semester

L	T	P	C
4	0	0	3

MATERIALS CHARACTERIZATION

Course objective: *The course presents the principles and methods of characterizing the structure and other aspects of materials. Various advanced characterizing techniques and their application will be studied.*

UNIT –I

Learning Objectives: *To understand various characterization techniques for solids*

Introduction: Scope of subject, classification of techniques for characterization, macro and micro-characterization structure of solids.

UNIT -II

Learning Objectives: *This Unit discuses different methods of characterization.*

Bulk Averaging Techniques: Thermal analysis, DTA, DSC, TGA, dilatometry, resistivity/conductivity.

UNIT –III

Learning Objectives: *This Unit Throws more light on characterization techniques.*

Optical & X-ray Spectroscopy: Atomic absorption spectroscopy, X-ray spectrometry, infrared spectroscopy and Raman spectroscopy.

UNIT –IV

Learning Objectives: *To understand more about metallographic characterization techniques.*

Metallographic Techniques: Optical metallography, image analysis, quantitative phase estimation.

UNIT –V

Learning Objectives: *It deals with Diffraction methods of characterization.*

Diffraction Methods: X-ray diffraction (crystal systems and space groups, Bravais lattices, direct and reciprocal lattice, Bragg law, powder diffraction and phase identification, single crystal diffraction, structure factor, X-ray crystal structure determination).

UNIT -VI

Learning Objectives: *To understand Electron and optical methods of characterization.*

Electron optical Methods*: Scanning electron microscopy and image formation in the SEM.*

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.

Text Books

1. The Principles of metallogrphy laboratory practices –George L.Khel-Eurasia publishing house (Pvt Ltd)
2. Transmission electron Microscopy of metals –Garet Thomas.-John wiley and sons.

Reference Books

1. Modern Metallographic Techniques & their application – victor phillips.
2. Physical Metallurgy, Part – I – RW Chao and P. Haasan.
3. Experimental Techniques in Physical Metallurgy – VT Cherepin and AK Mallik.
4. Electron Microscopy in the study of materials –P.J.Grundy.

III Year – II Semester

L	T	P	C
4	0	0	3

METAL FORMING

(Course Objective:*To understand the basic concepts of metal forming and acquire knowledge for the design of press tools needed for metal forming operations)*

UNIT – I

(Learning Objective: To understand basic concepts of yield criteria and theories of failure to develop solutions of material behavior under varied loading conditions)

STRESS TENSOR AND YIELD CRITERIA: state of stress, components of stress, symmetry of stress tensor, principal stresses, stress deviator, Von Mises, Tresca yield criteria, comparison of yield criteria, Octahedral shear stress and shear strain, Forming load calculations.

UNIT – II

(Learning Objective: To study mechanics of metal working and understand material flow behavior under different service conditions in metal forming. It also makes the students to understand the role of friction and lubrication in development of residual stresses during deformation)

FUNDAMENTALS OF METAL FORMING: Classification of forming processes, 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

(Learning Objective: To understand operations of various forging equipment and principles of variety of forging operations. Also to understand selection procedures of process parameters for improvement of process capability and defect free products)

FORGING : Forging-types of presses and hammers, Classification, Open die forging and Closed die forging, die design, forging equipment, forging in plane strain, calculation of forging loads, forging defects- causes and remedies, residual stresses in forging.

UNIT – IV

(Learning Objective: To understand effect of various process parameters during rolling operations and determination of rolling loads that help in designing proper roll mills with improved product yields)

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 – V

(Learning Objective: To understand extrusion and drawing processes and analyze the processes to develop optimal process parameters for a defect free product)

EXTRUSION AND DRAWING : Direct and indirect extrusion, variables affecting extrusion, deformation pattern, equipments, design of extrusion die, hydrostatic extrusion, defects and remedies, Analysis of extrusion force, tube extrusion and production of seamless pipe and tube. Drawing of rods, wires and tubes**.** Simple problems

UNIT – VI

(Learning Objective: To make the students aware of specialized forming processes and their specific applications to improve their analytical and simulation skills)

Sheet Metal Forming and Other Processes: Forming methods - Shearing, blanking, bending, stretch forming, deep drawing. Types of dies used in press working, defects in formed part and remedial measures, sheet metal formability, formability limit diagram.

High velocity forming: Comparison with conventional forming. Explosive forming, Electro hydraulic, Electro Magnetic forming, Dynapak and Petro-forge forming.

(Course outcomes: The student should be able to

1. *Understand elements of plastic deformation which is required as a pre-requisite for studying fracture mechanics course*
2. *Design press tools which are essential for hot and cold working*
3. *Understand and can establish its superior material properties of deformed components produced)*

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested periodically in classes. Unit tests are to be conducted at the end of each unit).

Text Books

1 Dieter.G.E ., "Mechanical Metallurgy", McGraw-Hill Co., SI Edition, 1995.

2 Nagpal.G.R., "Metal Forming Processes", Khanna Pub., New Delhi, 2000.

References

1 Kurt Lange "Handbook of Metal Forming", Society of Manufacturing Engineers. Michigan, USA, 1988

2 Avitzur, "Metal Forming - Processes and Analysis", Tata McGraw-Hill Co., New Delhi, 1977.

3 ASM Metals Handbook. Vol.14, "Forming and Forging", Metals Park, Ohio, USA, 1990.

4 Taylor Altan, Soo I.K. Oh, Harold.L.Gegel. "Metal Forming: Fundamentals and Applications", ASM, Metals Park, Ohio, USA, 1983.

WASTE WATER MANAGEMENT
(OPEN ELECTIVE)

Learning Objectives:

- Outline planning and the design of waste water collection ,conveyance and treatment systems for a community/town/city
- Provide knowledge of characterization of waste water generated in a community
- Impart understanding of treatment of sewage and the need for its treatment
- Summarize the appurtenance in sewage systems and their necessity
- Teach planning and design of septic tank and imhoff tank and the disposal of the effluent from these low cost treatment systems
- Effluent disposal method and realize the importance of regulations in the disposal of effluents in rivers

UNIT-I:

Introduction to Sanitation-Systems of sanitation- relative merits and demerits - collection and conveyance of waste water - classification of sewerage systems-Estimation of sewage flow and storm water drainage- fluctuations-types of sewers- Hydraulics of sewers and storm drains-design of sewers- appurtenances in sewerage- cleaning and ventilation of sewers

UNIT-II:

Pumping of wastewater: Pumping stations-location- components- types of pumps and their suitability with regard to wastewaters.

House Plumbing: Systems of plumbing-sanitary fittings and other accessories-one pipe and two pipe systems-Design of building drainage

UNIT-III:

Sewage characteristics-Sampling and analysis of waste water-Physical, chemical and Biological examination-measurement of BOD & COD- BOD equations

Treatment of sewage: Primary treatment- Screens-grit chambers- grease traps- floatation-sedimentation-design of preliminary and primary treatment units.

UNIT-IV:

Secondary treatment: Aerobic and anaerobic treatment process -comparison.

Suspended growth process: Activated sludge process, principles, design and operational problems, modifications of Activated sludge processes, Oxidation ponds, Aerated Lagoons.

Attached Growth process: Trickling Filters-mechanism of impurities removal-classification-design - operation and maintenance problems. RBCs. Fluidized bed reactors

UNIT-V:

Miscellaneous Treatment Methods: Nitrification and Denitrification- Removal of phosphates-UASB- Membrane reactors- Integrated fixed film reactors. Anaerobic Processes: Septic Tanks, Imhoff tanks- working principles and Design-disposal of septic tank effluent-FAB Reactors

UNIT-VI:

Bio-solids (sludge) management: Characteristics- handling and treatment of sludge-thickening-anaerobic digestion of sludge

Disposal of sewage: Methods of disposal- disposal into water bodies- Oxygen sag Curve- Disposal into sea-disposal on land- sewage sickness

Outcomes:

By the end of successful completion of this course, the students will be able to:

- Plan and design the sewerage systems
- Characterization of sewage
- Select the appropriate appurtenances in the sewerage systems
- Select the suitable treatment flow for sewage treatment
- Identify the critical point of pollution in a river for a specific amount of pollutant disposal into the river

Text Book:

1. Waste water Engineering Treatment and Reuse by Metcalf & Eddy, Tata McGraw- Hill edition.
2. Elements of Environmental Engineering by K.N. Duggal, S.Chand & Company Ltd. New Delhi, 2012.
3. Environmental Engineering by Howard S.Peavy , Donald R. Rowe, Teorge George Tchobanoglus- Mc-Graw-Hill Book Company, New Delhi, 1985
4. Wastewater Treatment for pollution control and Reuuse, by soli.J Areivala, sham R Asolekar, Mc-GrawHill, New Delhi; 3rd Edition
5. Industrial water & wastewater management by KVSG MuraliKrishna

Reference Book:

1. Environmental Engineering-II: Sewage disposal and Air pollution Engineering , by Garg, S.K.,: Khanna publishers
2. Sewage treatment and disposal by Dr.P.N.Modi & Sethi.
3. Environmental Engineering, by Ruth F. Weiner and Robin Matthews- 4th Edition Elsevier, 2003
4. Environmental Engineering by D. Srinivasan, PHI Learning private Limited , New Delhi,2011.

III Year – II Semester

L	T	P	C
4	0	0	3

ROBOTICS

(OPEN ELECTIVE)

Course Objectives:

1. To give students practice in applying their knowledge of mathematics, science, and Engineering and to expand this knowledge into the vast area of robotics.
2. The students will be exposed to the concepts of robot kinematics , Dynamics, Trajectory planning.
3. Mathematical approach to explain how the robotic arm motion can be described.
4. The students will understand the functioning of sensors and actuators.

UNIT-I

INTRODUCTION: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

UNIT – II

COMPONENTS OF THE INDUSTRIAL ROBOTICS: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

UNIT – III

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems.

MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT – IV

Differential transformation and manipulators, Jacobians – problems

Dynamics: Lagrange – Euler and Newton – Euler formulations – Problems.

UNIT V

General considerations in path description and generation. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages-description of paths with a robot programming language..

UNIT VI

ROBOT ACTUATORS AND FEED BACK COMPONENTS:

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors.

Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

ROBOT APPLICATIONS IN MANUFACTURING: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

Text Books:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.

References:

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall
3. Robot Analysis and Control / H. Asada and J.J.E. Slotine / BSP Books Pvt.Ltd.
4. Introduction to Robotics / John J Craig / Pearson Edu.

Course outcomes:

Upon successful completion of this course you should be able to:

1. Identify various robot configuration and components,
2. Select appropriate actuators and sensors for a robot based on specific application
3. Carry out kinematic and dynamic analysis for simple serial kinematic chains
4. Perform trajectory planning for a manipulator by avoiding obstacles.

III Year – II Semester

L	T	P	C
4	0	0	3

DATA BASE MANAGEMENT SYSTEMS
(OPEN ELECTIVE)

OBJECTIVES

- To learn the principles of systematically designing and using large scale Database Management Systems for various applications.

UNIT-I: An Overview of Database Management, Introduction- What is Database System- What is Database-Why Database- Data Independence- Relation Systems and Others- Summary,
Database system architecture, Introduction- The Three Levels of Architecture-The External Level- the Conceptual Level- the Internal Level- Mapping- the Database Administrator-The Database Management Systems- Client/Server Architecture.

UNIT-II:
The E/R Models, The Relational Model, Relational Calculus, Introduction to Database Design, Database Design and Er Diagrams-Entities Attributes, and Entity Sets-Relationship and Relationship Sets-Conceptual Design With the Er Models, The Relational Model Integrity Constraints Over Relations- Key Constraints –Foreign Key Constraints-General Constraints, Relational Algebra and Calculus, Relational Algebra- Selection and Projection- Set Operation, Renaming – Joins- Division-More Examples of Queries, Relational Calculus, Tuple Relational Calculus- Domain Relational Calculus.

UNIT-III:
Queries, Constraints, Triggers: The Form of Basic SQL Query, Union, Intersect, and Except, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and Active Database.

UNIT-IV:
Schema Refinement (Normalization) : Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF).

UNIT-V:
Transaction Management and Concurrency Control:
Transaction, properties of transactions, transaction log, and transaction management with SQL using commit rollback and savepoint.
Concurrency control for lost updates, uncommitted data, inconsistent retrievals and the Scheduler. Concurrency control with locking methods : lock granularity, lock types, two phase locking for ensuring serializability, deadlocks, Concurrency control with time stamp ordering : Wait/Die and Wound/Wait Schemes, Database Recovery management : Transaction recovery.

UNIT-VI:

Overview of Storages and Indexing, Data on External Storage- File Organization and Indexing – Clustered Indexing – Primary and Secondary Indexes, Index Data Structures, Hash-Based Indexing – Tree-Based Indexing, Comparison of File Organization

OUTCOMES

- Describe a relational database and object-oriented database.
- Create, maintain and manipulate a relational database using SQL
- Describe ER model and normalization for database design.
- Examine issues in data storage and query processing and can formulate appropriate solutions.
- Understand the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage.
- Design and build database system for a given real world problem

Text Books:

1**. Introduction to Databse Systems, CJ Date, Pearson**

2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGraw Hill 3rd Edition

3. Database Systems - The Complete Book, H G Molina, J D Ullman, J Widom Pearson

References Books:

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.

2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education

3. Introduction to Database Systems, C.J.Date Pearson Education

III Year – II Semester

L	T	P	C
4	0	0	3

CAD/CAM

(OPEN ELECTIVE)

Course Objectives:

The general objectives of the course are to enable the students to

1. Understand the basic fundamentals of computer aided design and manufacturing.
2. To learn 2D & 3D transformations of the basic entities like line, circle, ellipse etc
3. To understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication
4. To learn the part programming, importance of group technology, computer aided process planning, computer aided quality control
5. To learn the overall configuration and elements of computer integrated manufacturing systems.

UNIT – I

Computers in industrial manufacturing, product cycle, CAD / CAM Hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, storage devices.

COMPUTER GRAPHICS: Raster scan graphics coordinate system, database structure for graphics modelling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

UNIT – II

GEOMETRIC MODELING: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

DRAFTING AND MODELING SYSTEMS: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modelling.

UNIT – III

PART PROGRAMMING FOR NC MACHINES: NC, NC modes, NC elements, CNC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming. Direct Numerical Control, Adaptive Control.

UNIT – IV

GROUP TECHNOLOGY: Part family, coding and classification, production flow analysis, types and advantages.

Computer aided processes planning – importance, types.

FMS-Introduction, Equipment, Tool management systems, Layouts, FMS Control

UNIT – V

COMPUTER AIDED QUALITY CONTROL: Terminology used in quality control, use of computers in Quality control. Inspection methods- contact and noncontact types, computer aided testing, integration of CAQC with CAD/CAM.

UNIT – VI

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Types of manufacturing systems, machine tools and related equipment, material handling systems, material requrirement planning, computer control systems, human labor in manufacturing systems, CIMS benefits.

Text Books:

1. CAD / CAM Principles and Applications/PN Rao / McGraw-Hill
2. Automation, Production systems & Computer integrated Manufacturing/ M.P. Groover/Pearson Education

References:

1. Mastering CAD / CAM / Ibrahim Zeid / McGraw-Hill
2. Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson
3. Computer Numerical Control Concepts and programming / Warren S Seames / Thomson learning, Inc
4. Product manufacturing and cost estimation using CAD/CAE/ Kuang Hua Chang/Elsevier Publishers

Course Outcome:

At the end of the course the students shall be able to:

1. Describe the mathematical basis in the technique of representation of geometric entities including points, lines, and parametric curves, surfaces and solid, and the technique of transformation of geometric entities using transformation matrix
2. Describe the use of GT and CAPP for the product development
3. Identify the various elements and their activities in the Computer Integrated Manufacturing Systems.

III Year – II Semester

L	T	P	C
4	0	0	3

FUNCTIONAL MATERIALS
(DEPARTMENTAL OPEN ELECTIVE)

(Course objective: The main scope and objective is to obtain knowledge over the properties, production and applications of various functional materials)

UNIT -I
(Learning Objective: To know the properties and applications various electronic and magnetic materials)

Electronic and Magnetic Materials:

Types of magnetic materials, Ferrites and Garnets, Weiss theory of ferro magnetism, Soft and Hard magnetic materials , Fine particle magnets, magnetic tapes and films, Intrinsic and Extrinsic Semiconductors, band gap measurements, Determination of carrier concentration in Semiconductors with temperature , Direct and Indirect band gap Semiconductors, Hall effect.

UNIT – II
(Learning Objective: The student should learn the properties and applications of superconductors and insulating materials)

High temperature Superconductors- properties and applications. Insulating materials- types, properties and applications. Types of polarization, frequency and temperature dependence of polarization, field vectors and their relation, Ferro electricity and piezo electricity, Optical properties of dielectrics.

UNIT – III
(Learning Objective: The student should know the fundamentals of nuclear materials)

FUEL MATERIALS

Radiation, fission, reactor and reactor elements, Characteristics of fission materials – Density, Melting point, Electrical and Thermal Conductivity. Properties and applications of U, Th, Pu, zr and B for nuclear purpose..

UNIT – IV
(Learning Objective: The student should know the fundamentals of clad materials and their fabrication))

CLAD MATERIALS

Fuel rods: manufacture of fuel rods, fabrication of fuel rods, Oxide fuel element, carbide elements, their reprocessing, cladding materials requirements of Cladding materials – aluminium, Stainless steel and Zirconium alloys, their preparation and fabrication

UNIT – V
(Learning Objective: To lean the importance, properties and applications of polymeric Biomaterials)

POLYMERIC BIOMATERIALS

Polymers used as Biomaterials, Sterilisation, Surface Modification for improving bio compatibility, biodegradable polymeric materials, Tissue derived Biomaterials, Soft Tissue Replacement, Hard Tissue Replacement, Preservation Techniques.

UNIT – VI

(Learning Objective: To understand the biocompatibility of smart materials in various applications)

BIOMATERIAL APPLICATION OF SMART MATERIALS

Introduction, Properties, Biocompatibility, Shape Memory effect, Super Elasticity, Hysterisis, Anti – Kinking, Application with examples – Orthopedic, Dental, Surgical Instruments, Stent, Artificial Urethral Valves.

Text Books:

1. R. Bose, L.P. Sgepard, J. Wulff, Electronic Properties, Wiley Eastern Pvt. Ltd
2. Joseph D. Bronzino, "The Bio Medical Engineering Handbook", Vol.I, CRC Press, 2000.

References :

1. Mel Schwartz, " Encyclopedia of Smart Materials", Vol. I, John Wiley and Sons, USA, 2002.
2. Kopelman., "Materials for nuclear Reactors", McGraw-Hill, 1970.
3. Kenneth Jay., "Nuclear Power – Today and Tomorrow", Methven, 1961.
4. S.M. Sze, VLSI Technology, McGraw Hill International Edition, 1988.
5. Myer Kutz, "Handbook of Material Selection", John Wiley and Sons, USA, 2002.
6. Andreas F Von Recum. "Handbook of Evolution of Biomaterials", 2nd Edition, Taylor and Francis, 1999.

(Course outcomes: The student should be able to know the fundamentals of functional materials, their properties and applications)

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested periodically in classes).

III Year – II Semester

L	T	P	C
4	0	0	3

METALLURGICAL ANALYSIS
(DEPARTMENTAL OPEN ELECTIVE)

Course objective: To study the methods of analysis of various metals and alloys quantitatively and qualitatively.

UNIT-I:
(Learning objective: To know the importance of various methods of Metallurgical anaslysis.)
Importance of chemical analysis, scope of metallurgical analysis, classification of various methods used in metallurgical analysis. Solution preparations, normality, molarity, molality, Equivalent weight. Dissolution of ores in general, dissolution of metals and alloys.

UNIT-II :
(Learning objective: To know the various methods of qualitative analysis of ores and metals)
Chemical Analysis - Basic Principles - theory of indicators –Conventional solution methods for qualitative analysis of ores, fluxes, slags, metals and refractories.

UNIT-III:
(Learning objective: To know the various methods of qualitative analysis of a few ferrous and non-ferrous metals and alloys)
Qualitative analysis of common non-ferrous alloys such as brasses, bronzes and solders. Estimation of C, S, Si, Mn and P in cast iron and steel.

UNIT-IV:
(Learning objective: To estimate various elements present in various ores)
Estimation of Cr, Ni, Mo, W and V in alloy steels. Determination of iron in iron ore, manganese in manganese ores, lime in limestone, fire-assay of precious metals.

UNIT-V:
(Learning objective: To describe various instrumental methods of analysis and to compare the results with different wet methods)
Instrumental analysis: Importance of instrumental analysis –Comparison with standard wet chemical methods - Fundamental Physicochemical principles involved and equipment required in absorptiometry i.e, colorimetry and spectrophotometry, colorimetric titration.

UNIT-VI:
(Learning objective: To describe various advanced instrumental methods of analysis)
Spectroscopy, potentiometry, amperometric titration. Calorimetric titrations, polarography, conductometry, electro-analysis and flame photometry.

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (with special focus on academically weak students) at the end of each unit).

Text Books:

1. S.K.Jain-Metallurgical analysis.

References :

1. Iyer V.G., Metallurgical Analysis: BHU Press, Varanasi.
2. Agarwal, B.C. and Jain S.P., A Text Book of Metallurgical Analysis, Khanna Publishers, Delhi -1963.
3. Snell Foster D and Frank M Biffen: Commercial methods.of analysis / Che. Publishing Co.,1964
4. Vogel Al., A Text Book of Quantitative Inorganic Analysis Longman ELBS 1962.
5. Willard H.H.etal: Instrumental Methods of analysis Van Nostrand.

III Year – II Semester

L	T	P	C
0	0	3	2

MATERIALS JOINING LAB

OBJECTIVE

To give hands-on practice on various arc welding practices, to study the microstructure of welds and to write the welding reports

LIST OF EXPERIMENTS

1. Arc striking practice.
2. Bead-on-plate welding
3. Effect of welding parameters on weld bead
4. GTA welding
5. GMA welding
6. Submerged arc welding
7. Microstructural observation of weldments
   - Carbon steel
   - Stainless steel
   - Aluminium alloy
   - Titanium alloy
   - Dissimilar joints
8. Weld overlaying of austenitic stainless steels on mild steels
9. Practice for preparation of welding procedure specification.
10. Practice for preparation of procedure qualification record.

LIST OF EQUIPMENTS :

1. Multipower welding source capable of SMAW,SAW, GMAW,GTAW. - 1No
2. Individual power sources and accessories for MMAW - 4 Nos.
3. Metallurgical microscopes - 4 Nos.

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

II.

2. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

III Year – II Semester

L	T	P	C
0	0	3	2

METAL FORMING LAB

(Course Objectives:To enable the students to understand the principles and practice of metal forming.)

LIST OF EXPERIMENTS:

1. Tension test - finding out n and k
2. Cold rolling of aluminium and brass sheets
3. Recrystallisation annealing of cold worked alloys
4. Hammer forging
5. Upset forming using Hydraulic Press
6. Simulation of metal flow using a model material (plasticine, etc)
7. Identification of defects in Wrought alloys
8. Macrostructure of Wrought materials
9. Microstructure of Cold worked and hot worked metals
10. Effect of lubricants on metal forming
11. Production of metal powders
12. Determination of particle size and shapes
13. Determination of apparent and tap densities
14. Determination of flow rate of metal powders

LIST OF EQUIPMENTS

1. Hounsfield tensometer	
2. Cold rolling mill	1 No.
3. Muffle furnace	1 No.
4. Forging hammer	1 No.
5. Hydraulic press	1 No.
6. Metallurgical microscope	1 No.
7. Various die sets	1 Set
8. DC regulated power supply	1 No
9. Stereo microscope	1 No
10. Sieve shaker with sieve set	1 No
11. Hall flow meter	1 No

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

II.

1. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

III Year – II Semester

L	T	P	C
0	0	3	2

MATERIALS CHARACTERIZATION LAB

(Course Objectives:To enable the students to understand the principles of materials characterization.)

LIST OF EXPERIMENTS

1. Optical microscopy – observing bright field and dark field imaging through optical microscope
2. Optical microscopy – grain size measurement
3. Optical microscopy- inclusion analysis in steel
4. X-ray diffractrometry- phase identification
5. X-ray diffractrometry- crystal structure determination and precise lattice parameter measurement
6. X-ray diffractrometry- crystallite size and lattice strain measurement
7. Electron microscopy-fractography analysis
8. Electron microscopy-BSE imaging in composite microstructures
9. Microchemical analysis using EDS
10. Thermal analysis- TG, DTA and DSC analysis for determining thermodynamic parameters

LIST OF EQUIPMENTS

1. Metallurgical microscope with image analysis 1 No.
2. X-ray diffractometer 1 No.
3. Scanning electron microscope with energy dispersive X-ray spectrometer 1 No.
4. Simultaneous thermal analyser 1 No.

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs wherever necessary*
6. *Viva-voce.*

II.

2. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

III Year – II semester

L	T	P	C
0	2	0	0

PROFESSIONAL ETHICS AND HUMAN VALUES

Course Objectives:

***To give basic insights and inputs to the student to inculcate Human values to grow as a responsible human beings with proper personality.**
***Professional Ethics instills the student to maintain ethical conduct and discharge their professional duties.**

UNIT I: Human Values:
Morals, Values and Ethics – Integrity –Trustworthiness - Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value Time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.

UNIT: II: Principles for Harmony:
Truthfulness – Customs and Traditions -Value Education – Human Dignity – Human Rights – Fundamental Duties - Aspirations and Harmony (I, We & Nature) – Gender Bias - Emotional Intelligence – Salovey – Mayer Model – Emotional Competencies – Conscientiousness.

UNIT III: Engineering Ethics and Social Experimentation:
History of Ethics - Need of Engineering Ethics - Senses of Engineering Ethics- Profession and Professionalism —Self Interest - Moral Autonomy – Utilitarianism – Virtue Theory - Uses of Ethical Theories - Deontology- Types of Inquiry –Kohlberg's Theory - Gilligan's Argument –Heinz's Dilemma - Comparison with Standard Experiments — Learning from the Past –Engineers as Managers – Consultants and Leaders – Balanced Outlook on Law - Role of Codes – Codes and Experimental Nature of Engineering.

UNIT IV: Engineers' Responsibilities towards Safety and Risk:
Concept of Safety - Safety and Risk – Types of Risks – Voluntary v/sInvoluntary Risk – Consequences - Risk Assessment – Accountability – Liability - Reversible Effects - Threshold Levels of Risk - Delayed v/sImmediate Risk - Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

UNIT V: Engineers' Duties and Rights:
Concept of Duty - Professional Duties – Collegiality - Techniques for Achieving Collegiality – Senses of Loyalty - Consensus and Controversy - Professional and Individual Rights –Confidential and Proprietary Information - Conflict of Interest-Ethical egoism - Collective Bargaining – Confidentiality - Gifts and Bribes - Problem solving-Occupational Crimes- Industrial Espionage-Price Fixing-Whistle Blowing.

UNIT VI: Global Issues:
Globalization and MNCs –Cross Culture Issues - Business Ethics – Media Ethics - Environmental Ethics – Endangering Lives - Bio Ethics - Computer Ethics - War Ethics – Research Ethics - Intellectual Property Rights.

- Related Cases Shall be dealt where ever necessary.

Outcome:

***It gives a comprehensive understanding of a variety issues that are encountered by every professional in discharging professional duties.**

***It provides the student the sensitivity and global outlook in the contemporary world to fulfill the professional obligations effectively.**

References:

1. Professional Ethics by R. Subramaniam – Oxford Publications, New Delhi.
2. Ethics in Engineering by Mike W. Martin and Roland Schinzinger - Tata McGraw-Hill – 2003.
3. Professional Ethics and Morals by Prof.A.R.Aryasri, DharanikotaSuyodhana - Maruthi Publications.
4. Engineering Ethics by Harris, Pritchard and Rabins, Cengage Learning, New Delhi.
5. Human Values & Professional Ethics by S. B. Gogate, Vikas Publishing House Pvt. Ltd., Noida.
6. Engineering Ethics & Human Values by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd – 2009.
7. Professional Ethics and Human Values by A. Alavudeen, R.Kalil Rahman and M. Jayakumaran – University Science Press.
8. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill - 2013
9. Human Values And Professional Ethics by Jayshree Suresh and B. S. Raghavan, S.Chand Publications

IV Year – I Semester

L	T	P	C
4	0	0	3

PROCESS MODELLING

Course objective: To impart knowledge on mathematical and physical modelling in metallurgical processes. The student should also get knowledge on the applications of CFD and ANSYS)

UNIT-I

Learning objective: To know various mathematical models and their advantages

Mathematical modeling, physical simulation, advantages and limitations; process control, instrumentation and data acquisition systems

UNIT-II

Learning objective: To differentiate finite element and finite differential modelling.

Review of transport phenomena, review of differential equations, review of numerical methods; concept of physical domain and computational domain, assumptions and limitations in numerical solutions, introduction to FEM & FDM

UNIT-III

Learning objective: To explore the usage of software packages like Ansys, Thermo cal, and CFD. To evaluate the expert systems and artificial intelligence in metallurgical processes.

Introduction to software packages – useful websites and generic information about different products - ANSYS, Thermocalc, CFD;

UNIT-IV

Learning objective: know the application of artificial intelligence in various metallurgical problems

Introduction to expert systems and artificial intelligence; demonstration / practical training in some software packages.

UNIT-V

Learning objective: To develop physical models in various metallurgical applications.

Physical modeling – cold and hot models; case studies of water models, use of computers for the construction of phase diagrams, alloy design, crystallography, phase transformations and thermo chemical calculations.

UNIT-VI

Learning objective: To analyse different case studies related to process modelling.

Case studies from literature – pertaining to modeling of solidification / heat transfer, fluid flow, casting, welding and liquid metal treatment

Text Books:

1. *Szekely J., Themelis N. J., 'Rate Phenomena in Process Metallurgy', Wiley, 1971*
2. *P.S. Ghosh Dastidar, "Computer Simulation of Flow and Heat Transfer", Tata McGraw Hill, New Delhi, 1998*

IV Year – I Semester

L	T	P	C
4	0	0	3

ELECTRO METALLURGY AND CORROSION

(Course Objective: To understand the basic fundamentals of electro chemistry, electro chemical principles and electro winning techniques. To know the principles of corrosion and the protection and preventive methods.)

UNIT- I

(Learning Objective: To know the basic concepts of applied electro chemistry.)

Applied electrochemistry - electrochemical methods of analysis estimation by electrolysis. Electrophoresis-measuring instruments for experimental study of electro-chemistry.

UNIT –II

(Learning Objective: To know the basic principles of Faraday's law and polarization.)

Review of electrochemical Principles. –Faradays laws-Electrode potentials –Cathodic and anodic reactions- polarization over voltage.

UNIT –III

(Learning Objective: To study the electro winning techniques)

General discussion on the electro winning of metals eg. Cu, Zn,metallic clouds, anode effect. Differences between electro winning and electro refining.

UNIT-IV

(Learning Objective: To get acquainted with the electro plating techniques.)

Current efficiency, throwing power, electro plating of Cu, Ni, Cr, Zn and alloy Plating. Testing methods of electro deposite.

UNIT-V

(Learning Objective: To learn the principles and various types of corrsion.)

Corrosion Introduction, classification, forms of corrosion. Uniform corrosion, galvanic corrosion, and galvanic series. Beneficial applications of galvanic corrosion, Pitting corrosion, season cracjing, dezincification. Crevice corrosion, stress corrosion cracking, Intergranular corrosion, weld decay,Knife-line attack,Errosion corrosion,frettling corrosion.

UNIT-VI

(Learning Objective: To understand various protective methods of corrosion.)

Corrosion protection methods, selection of materials for corrosion services, selection of environment-use of inhibitors, surface protection methods including painting, metallic coating. Cathodic protection, sacrificial anode. Difference between cathodic and anodic protection.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested periodically in classes. Unit tests are to be conducted at the end of each unit).

Text Books

1. Introduction to Electrometallurgy & Corrosion by R.SharanS.Narain-Standard Publishers.
2. Corrosion Engineering-Fontana

References

1. Electro metallurgy-Blum.
2. Material science- Van Vlack
3. Elements of Physical Metallurgy-A.G.Guy.

IV Year – I Semester

L	T	P	C
4	0	0	3

CERAMIC MATERIALS

(Course Objective: To provide a comprehensive coverage on fundamentals of ceramics, structures of ceramics, phase diagrams of ceramic materials, synthesis of ceramic powders and ceramic processing techniques).

UNIT – I

(Learning Objectives: To study the basic classification of ceramic materials)

Introduction: Definition – Classification of Ceramics – Traditional Ceramics – Structural Ceramics – Fine Ceramics – Bio ceramics – Ceramic super conductors.

UNIT – II

(Learning Objectives: To get acquainted with the microstructural features of various ceramic crystals)

Structure of Ceramic Crystals: Atomic structure – Interatomic bonds – Atomic bonding in Solids – Crystal structures – Grouping of ions and Pouling's rules – Oxide structures – Silicate structures – Glass formation – Models of glass structure Types of glasses.

UNIT – III

(Learning Objectives: To get acquainted with the two component and three component systems of ceramic materials)

Ceramic Phase - Equilibrium Diagrams:

Two and three component systems Al_2O_3 – SiO_2, BaO – TiO_2 and MgO – Al_2O_3 – SiO_2

UNIT –I V

(Learning Objectives: To study the methods of production of ceramic powders)

Powder Preparation Techniques:

Preparation of Al_2O_3, ZrO_2, SiC, Si_3N_4, BN & B_4C Powders by various Techniques. Sol-gel technology – Precipitation, Coprecipitation - Hydrothermal precipitation.

UNIT – V

(Learning Objectives: To get acquainted with the advanced ceramic processing techniques)

Ceramic Processing Techniques: Hot Pressing – Hot Isostatic Pressing - (HIP), Spark plasma sintering

UNIT – VI

(Learning Objectives: To know the sintering and casting and other processing methods of ceramic materials)

Sintering – Sinter / HIP - Injection moulding - Slip casting - Tape casting – Gel casting – Extrusion

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (With a focus on academically weak students) at the end of each unit.)

Text Books:

1. Introduction to Ceramics – W.D. Kingery et al. 1976, John Wiley
2. Ceramic processing- M. N. Rahaman 2006, CRC Press

Reference

1 Fundamentals of ceramics- M.W.Barsoum, IOP series, 2002

2 . Modern ceramic engineering, D. W. Richerson, 3rd edition, Talyer and Francis 2005

3. Callister's Mateials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley, 2015

IV Year – I Semester

L	T	P	C
4	0	0	3

POWDER METALLURGY

(Course Objective: To get familiarize with the powder production, characterization and consolidation techniques. To get knowledge over the applications of powder metallurgy)

UNIT – I

(Learning Objective: To get acquainted with the importance of powder metallurgy and to know the advantages of PM techniques over other fabrication techniques)

Introduction: Emergence and importance of powder metallurgy**,** Comparision of powder metallurgy with other fabrication techniques, its scope and limitations.

UNIT – II

(Learning Objective: To get an idea of powder characterization.)

Characterization and production of powders: General characteristics of metal powders, particle shape flow rate, apparent density, and specific surface are, particle size distribution.

UNIT – III

(Learning Objective: To get acquainted with various powder production methods)

Determination of powder characteristics; different methods of production of metal powders: influence of manufacturing process on powder characteristics.

UNIT – IV

(Learning Objective: To study the mechanism of compaction and sintering.)

Consolidation of Metal PowdersI: Compaction - Theory of consolidation: Pressure transimission in powders; compressibility and compactibility of powders; Green strength; Hot isostatic pressing; Powder rolling. Sintering - Mechanisms of Sintering; Factors affecting sintering; Activated sintering; Liquid phase sintering; Sintering atmospheres; Properties of sintered parts.

UNIT – V

(Learning Objective: To gain knowledge on various applications of powder metallurgy parts.)

Applications: Porous parts: Self-lubricating bearings, filters: Dispersion strengthened materials: Cu / Al2O3, Sintered Aluminum Powder.

UNIT –VI

(Learning Objective: To get acquainted with the advanced powder metallurgy materials.)

Electrical and Magnetic materials, Tungsten lamp filaments, electrical contacts, welding electrodes. Soft magnetic materials (Fe, Fe-N); Permanent magnets (Alnico, SnCo5), Cemented carbides; Cermets.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested periodically in classes. Unit tests are to be conducted at the end of each unit).

Text Book

1. Powder Metallurgy: Anish Upadhya and GS Upadhya- University Press, 2013
2. Powder Metallurgy, P.C. Angelo and R. Subramanian, PHI Pvt. Ltd., 2008

References

1. Powder Metallurgy, ASM Metals Hand Book , Vol. 7, 1984
2. Powder Metallurgy Science, Randall M. German, 1994

IV Year – I Semester

L	T	P	C
4	0	0	3

NUCLEAR MATERIALS
(ELECTIVE-I)

(Course objective: The main scope and objective is to obtain knowledge over various nuclear materials, their resources, properties and applications)

UNIT – I

(Learning objective: To study and understand the fundamental concepts of nuclear physics and nuclear chemistry)

Elementary nuclear physics and chemistry: Structure of nucleus, radioactivity, binding energy: nuclear interaction; fission and fusion: nuclear reaction; energy release and chain reactions; neutron cross-section; multiplication and criticality concepts and factors.

UNIT – II

(Learning objective: To obtain knowledge over the detection of radiation and necessary protection methods)

Mechanisms of moderation, radiation detection, radiation effects on fissile and non fissile materials; radiation damage and radiation growth; thermal cycling; protection against radiations.

UNIT – III

(Learning objective: To study and obtain knowledge over various types of reactor components)

Reactor components: Types of reactors and classification. Materials for nuclear reactors: Considerations in selection and properties of common materials used as fuels, their physical and chemical properties; canning materials; coolants; control rods; reflectors and shielding materials.

UNIT –IV

(Learning objective: To study and obtain knowledge over the production of reactor materials)

Production of reactor materials: Occurrence and general characteristics of nuclear minerals and their production.

UNIT – V

(Learning objective: To obtain knowledge over resources of various nuclear materials)

Indian resources: Flow sheets of processing of nuclear minerals for the production of nuclear grade uranium, thorium, beryllium and zirconium with emphasis on basic scientific principles involved; production and enriched uranium and fabrication of fuel elements.

UNIT – VI

(Learning objective: To obtain knowledge over the processing of nuclear fuels and nuclear power production)

Processing of irradiated fuel for recovery of Plutonium, Nuclear power production in India and its economics.

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (With a focus on academically weak students) at the end of each unit.)

Text Book:
An introduction to nuclear materials, K. L. Murty and Indrajit Charit, Wiley, 2013

References:

1. US Atomic Energy Commission and history of nuclear energy, Atomic energy commission, US Govt., 2013
2. Glasstone S and Snesonske A; Prncipales of Nuclear Reactor Engineering: Macmillan, London.
3. Grainger L Uranium and Thorium: George Newnes Ltd., London.
4. Gurinsky DH and Dienes JL Nulcears Fuels, Macmillan.
5. Proceedings of the symposium on Nuclear Science and Engineering – Bhabha Atomic Research Centre, Bombay.

IV Year – I Semester

L	T	P	C
4	0	0	3

MAGNETIC AND ELECTRONIC MATERIALS
(ELECTIVE-I)

(Objectives: The course gives the importance, properties, and applications of semi conductors and various types of magnetic materials)

UNIT-I

(Learning Objectives: To understand the concepts of electron theory of metals and thermoelectric phenomena.)

Review of electron theory of metals; Electrical and thermal conductivity – Classical approach and quantum mechanical considerations; Resistivity of pure metals and alloys, and ordered alloys; thermoelectric phenomena.

UNIT-II

(Learning Objectives: To study various types of semi conductors, their properties and applications)

Semiconductors: Band structures, intrinsic semiconductors, extrinsic semiconductors; Hall effect; Elemental and compound Semiconductors and their application; Super conductivity; super conducting materials; Structure and application.

UNIT-III

(Learning Objectives: To understand the concepts of ferromagnetism)

Ferromagnetism: Ferromagnetic domains; Hysteresis loops, magnetostriction and magnetoelectricity, origin of Hysteresis due to domain wall movement; soft magnetic alloys.

UNIT-IV

(Learning Objectives: To study the factors determining permeability of metals and alloys and other concepts associated with magnetic permeability)

Factors determining the permeability of metals and alloys; Effect of fundamental properties on permeability, Ni-Fe alloys, Fe-Co alloys, high permeability of iron and ferritic iron, Si – Fe alloys and Cu – Ni alloys.

UNIT-V

(Learning Objectives: To learn the properties and applications of ferro and ferri magnetic materials)

Amorphous ferromagnetic alloys and Ferro fluids: Preparation and structure of amorphous ferromagnetic and its application; Ferro fluids.

Ferri magnetic material; Spiral structure; Theory of ferrimagnetisms; magnetic structures of ferrites; permeability of ferrites; stress-induced anisotropy in ferrites; Applications of soft ferrites.

UNIT-VI

(Learning Objectives: To get acquainted with the properties, applications and other aspects of permanent magnetic materials)

Permanent magnetic materials: Energy product of a permanent magnet material; Behavior of permanent magnets under dynamic or recoil conditions; Alnicos; Fe- Cr-Co alloys. Cu-Ni-Fe and Cu-Ni-Co alloys; Fe-Co-Mo alloys, Pt-Co alloys; Permagnent, magnets based on the intermetallic compound Sm2 Cal2 Coercivity mechanisms; Applications of permanent magnetic; Temperature dependence of magnetic properties of permanent magnets;

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (With a focus on academically weak students) at the end of each unit.)

Text Books

1. Electrical, electronic and magnetic properties of solids, D. B. Sirdeshmukh, L. Sirdeshmukh, K. G. Subhadra, C. S. Sunanda, Springer, 2014
2. Introduction to solid state physics WSE (8^{th} edition), Wiley student edition

Reference

1. Electronic, magnetic and optical materials, Pradeep Fulay, CRC Press, 2010

IV Year – I Semester

L	T	P	C
4	0	0	3

LIGHT METALS AND ALLOYS
(ELECTIVE-I)

(Course Objective: To study the importance, extraction, properties and applications of various wrought and cast light metals and their alloys)

UNIT-I

Learning Objective: To learn the extraction process, properties and applications of Al and its alloys.
Aluminum and its alloys: Extraction – Properties – Applications. Wrought and Casting Alloys (Al-Cu, Al-Mn, Al-Si, Al-Mg, Al-Si-Mg, Al-Zn, Al-Li) – Corrosion resistance of Al alloys.

UNIT – II

(Learning Objective: To learn the extraction process, properties and applications of Be and its alloys.)
Properties of light metals - Extraction of Beryllium.

UNIT-III

(Learning Objective: To learn the extraction process, properties and applications of Ti and its alloys)
Extraction, Properties and applications of Titanium and its alloys.

UNIT-IV

Learning Objective: To learn the extraction process, properties and applications of Mg and its alloys
Magnesium – Classification – Casting alloys – Wrought alloys-properties and applications of Mg alloys.

UNIT-V

Learning Objective: To learn the extraction process, properties and applications of Zn and its alloys
Extraction, Properties and applications of Zn and its alloys

UNIT-VI

Learning Objective: To learn the extraction process, properties and applications of Zr and its alloys
Extraction, Properties and applications of Zr and its alloys

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (With a focus on academically weak students) at the end of each unit.

Text Book

1. Light alloys: Metallurgy of light metals, I. J. Polmear, 2nd edition, Edward Arnold publishers, 1989

References

1. Light alloys: from traditional alloys to nanocrystals, I.Polmear and David St. John, BH-Elsevier,4th edition 2006
2. ASM Metals Handbook Vol-1 & 2

IV Year – I Semester

L	T	P	C
4	0	0	3

HIGH TEMPERATURE MATERIALS
(ELECTIVE-II)

(Course objective: *To learn damage mechanism and failure of components of elevated temperatures* **)**

UNIT- I

(Learning objective: To know the fundamentals of creep, Creep curve , factors effecting creep and creep resistant materials)

CREEP: Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate, Creep resistant materials.

UNIT-II

(Learning objective: To know the rupture life of creep and creep facture mechanism)

DESIGN FOR CREEP RESISTANCE

Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

UNIT –III

(Learning objective: To know the types of fracture and their feature. To study the fracture maps for different alloys and oxides)

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

UNIT –IV

(Learning objective: To know the kinetic laws of oxidation. Hot corrosion and the factors effecting hot corrosion)

OXIDATION AND HOT CORROSION

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT –V

(Learning objective: To study the corrosion of super alloys and some strengthening mechanisms)

SUPERALLOYS AND OTHER MATERIALS

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase,

UNIT –VI

(Learning objective: To know the types of fracture and their feature. To study the fracture maps for different alloys and oxides)

Embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

Text Books

1. Callister's Mateials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley, 2015
2. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.

References

1. G. W. Meetham and M. H. Van-de-Voordee, Materials for high temperature applications, Springer 2000
2. Raj. R., “Flow and Fracture at Elevated Temperatures”, American Society for Metals, USA, 1985.
3. Hertzberg R. W., “Deformation and Fracture Mechanics of Engineering materials”, 4th Edition, John Wiley, USA, 1996.
4. Boyle J.T, Spencer J, “Stress Analysis for Creep”, Butterworths, UK, 1983.
5. Bressers. J., “Creep and Fatigue in High Temperature Alloys”, Applied Science, 1981.

IV Year – I Semester

L	T	P	C
4	0	0	3

METALLURGICAL FAILURE ANALYSIS
(ELECTIVE-II)

(Course Objective: To impart knowledge on the analysis of the probability of failure under various service conditions and methods to ensure safety)

UNIT I

Learning Objective: To understand various sources of failure engineering components.

Sources of failure: Material problems including chemical composition, microstructure, faulty selection, faulty heat treatment, corrosion susceptibility and defects; Mechanical irregularities including faulty design, mismatch and notch effects; Wrong welding fabrication and abnormal service conditions.

UNIT II

Learning Objective: To understand methods of sample collection and preservation of failed surfaces.

Failure analysis: First hand documentation, planning of steps of analysis, collection of back ground data and samples, selection, cleaning and preservation of fracture surface.

UNIT III

Learning Objective: To know the various methods/techniques of failure investigation.

Failure analysis methodology: Use of advanced instruments, macroscopic and microscopic examinations of fracture surface, selective application of non-destructive testing, mechanical testing and stress analysis, metallographic examination and analysis; Bulk and micro chemical analysis.

UNIT IV

Learning Objective: To understand different modes of failure and learn principles of fracture mechanics.

Fracture mechanics (FM): Applications of FM under static and dynamic loading, application of NDT for defect assessment and monitoring, analysis of failure mechanism, safety and residual life estimation. Fracture: Mechanisms and models of fracture, ductile flat-face and shear-face tensile fractures, brittle inter-granular and trans-granular fractures, embrittlement failure- Strain-age, quench-age, temper, hydrogen, sigma-phase and neutron embrittlement and blue brittleness; Factors influencing different types of fracture.

UNIT V

Learning Objective: To study various fracture mechanisms.

Failure mechanism: Fatigue, corrosion, stress corrosion cracking and elevated or cryogenic temperature failure- Metallurgical and mechanical factors affecting these failures, loading condition and stages of fracture, macroscopic and microscopic salient features of failure.

UNIT VI

Learning Objective: To know the report writing and documentation of failure analysis.

Result analysis and reporting: Correlations of observations and evidences, documentation, logical conclusions and remedial measures

Suggested Books:

1. Charlie R Brooks and Ashok Choudhury, Metallurgical Failure Analysis, 1992, McGraw Hill
2. Colangelo V.J. and Heiser F.A., Analysis of Metallurgical Failure, 2nd 1987 edition, Wiley-Interscience

References:

1. Shipley R.J. and Becker W.T., Failure Analysis and Prevention, ASM handbook, Vol. 11, ASM International 2002
2. Powell G.W. and Mahmoud S.E., Failure Analysis and Prevention, Metals Handbook, Vol. 11, 9th 1986 edition, ASM International
3. Cooper T.D., Prevention of structural failure-the role of quantitative nondestructive evaluation, ASM International 1975
4. Sachs N.W., Practical Plant Failure Analysis: A guide to understanding machinery deterioration and improving equipment reliability, Dekker Mechanical Engineering, CRC press 2006
5. Gulati R. and Smith R., Maintenance and Reliability Best Practices, Industrial Press 2009

IV Year – I Semester

L	T	P	C
4	0	0	3

BIO-MATERIALS
(ELECTIVE-II)

***(Course Objective:** To impart knowledge on structure-property relationship in biomaterials and their applications as implants)*

UNIT I

Learning objective: To understand the biocompatibility of various materials.

Introduction: Historical background, construction materials, impact of biomaterials, strength of biological tissues, performance of implants, tissue response to implants, interfacial phenomena, safety and efficacy testing 4

UNIT II

Learning objective: To analyse various metallic and ceramic materials for bio-medical applications

Metallic and Ceramic materials: Stainless steels, Co-Cr alloys, Tibased alloys, Nitinol, biological tolerance of implant metals, ceramic implant materials, alumina, yittria stabilized zirconia, hydroxyapatite glass ceramics carbons, restorable ceramics, composites.

UNIT III

Learning objective: To understand various polymers to understand for use as biomaterials.

Polymeric i mplant materials: Polymers in biomedical use, polyethylene, polypropylene, acrylic polymer, hydrogels, polyurethans, polyamides, biogradable synthetic polymers, silicon rubber, microorganisms in polymeric implants, polymer sterilization.

UNIT IV

Learning objective: To realise various materials for dental applications.

Dental Mat erials: Tooth composition and mechanical properties, impression materials, bones, liners, and varnishes for cavities, filling and restorative materials, oral implants, use of collagen in dentistry.

UNIT V

Learning objective: To know about Cardiovascular and regenerative materials

Cardiovascular and Orthopedic implants: Artificial heart, aorta and valves, geometry of circulation, vascular implants, cardiac pace makers, bone composition and properties, fracture healing, joint replacement, knee joint repair, bone regeneration with restorable materials.

UNIT VI

Learning objective:To know the chemical and biochemical degradation in polymers and ceramics

Degradation of Materials in the biological environment: Chemical and biochemical degradation of polymers, degradation effects on metals and ceramics, pathological classification of biomaterials

Text Books:

1 Bhat, S.V., Biomaterials, 2nd edition reprint 2010, Narosa Publishing House
2 Park J.B. and Lakes R.S., Biomaterials: An Introduction, 3rd edition, Springer press , 2007

Reference Books:

1 Park J.B. and Bronzino J.D., Biomaterials: Principals and Applications, CRC Press, 2003
2 Park J.B., Biomaterials Science and Engineering, Springer Press 1984
3 Rattner B.D., Hoffman A.S, Schoen F.J., Lemons J.E., Biomaterials Science: An Introduction to Materials in Medicine, Academic Press 2004

IV Year – I Semester

L	T	P	C
0	0	3	2

PROCESS MODELLING LAB

LIST OF EXPERIMENTS:

1. FEM: Ansys/Abacus – Thermal model
2. FEM: Ansys/Abacus – Stress based model
3. Phase predictions using Thermocalc
4. Solidification models using CFD
5. Optimization tools (ANOVA, Taguchi, Variance method etc.)
6. Construction of phase diagram using CALPHAD approach

LIST OF EQUIPMENT/ SOFTWARE

1. ANSYS/ Abacus
2. Thermocalc
3. Matlab

Assessment: The student's performance should be evaluated at the end of each class
At the end of each cycle, internal exams should be conducted in addition to the end examination

IV Year – I Semester

L	T	P	C
0	0	3	2

ELECTRO METALLURGY AND CORROSION LAB

LIST OF EXPERIMENTS:

1. Electroplating of copper on brass and to study the influence of current density on current efficiency.
2. Electroplating of Nickel using watt's bath and to study the influence of current density on current efficiency.
3. To anodise the given aluminium sample and to colour with a dye and to measure the thickness of the oxide film.
4. To determine the throwing power of electroplating bath.
5. Electroplating of chromium on mild steel and to study the influence of current density on current efficiency.
6. To understand the principles in galvanic cell corrosion using "Ferroxyl" indicating test solution.
7. To study the effect of inhibitors on corrosion of mild steel in an acidic solution.
8. To construct pourbiax diagrams using electro chemical thermodynamic data.
9. To study the pitting corrosion of aluminium, stainless steel in suitable environments.
10. To conduct electropolishing of stainless steel using Nitric acid batch.
11. To conduct electroless plating of tin on glass.
12. To conduct electroforming on hard plastics.

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

II.

1. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

IV Year – II Semester

L	T	P	C
4	0	0	3

COMPOSITE MATERIALS

Course Objective: *This subject deals with advantages, applications of various types of Composites, and their manufacturing methods.*

UNIT-I

Learning Objective: U*nderstanding of classification of composites based on the structure and matrices.*

Introduction definition- Classification of composite materials based on structure, matrix and reinforcement.

UNIT-II

Learning Objective: *Throws some light on applications and advantages of composites.*

Advantages of composites - application of composites - functional requirements of reinforcement and matrix.

UNIT-III

Learning Objective: *To learn preparation, properties and applications of different types of composites.*

Fibers: Preparation, properties and applications of glass fibers, carbon fibers, Kavlar fibers and metal fibers-properties and application of whiskers, particle reinforcements.

UNIT-IV

Learning Objective: *To understand various production methods of composites*

Manufacturing of advanced composites: Polymer matrix composites: Preparation of Moulding compounds and – hand lay up method – Autoclave method - Filament winding method - compression moulding – Reaction injection moulding.

UNIT-V

Learning Objective: *To understand the production methods of advanced composites*

Manufacturing of Metal Matrix Composites: Casting-Solid state diffusion technique. Cladding – Hot isostatic pressing. Manufacturing of Ceramic Matrix Composites: Liquid Metal infiltration-Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Brading, Weaving

UNIT-VI

Learning Objective: *To learn the response of composites to external stresses.*

Response of Composites to Stress: (a) Iso strain condition (b) Iso Stress condition (c) Load friction shared by the fibers

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. Composite Materials-K.K.Chawla, Springer, 2nd Edition, 1998
2. An introduction to composite materials, D. Hull an T.W. Clyne, 2nd edition, Cambridgeg University press, 1996

Reference:

1. Composites ASM Hand Book, Vol. 21, 9th edition, 1989
2. Fundamentals of composites: Materials, manufacturing, methods an applications, Society of manusfacturing engineers, 1989
3. Material Sciences and Technology – (R.. W. Cahn, P. Haasen, E, J, Kramer eds.) Vol 13 Structure and properties of composites (T. W. Chou ed.) VCH Winheim, 1993 – Composites by Cahn – VCH,

IV Year – II Semester

L	T	P	C
4	0	0	3

FERRO ALLOY TECHNOLOGY

(Course objective: The main scope and objective is to obtain knowledge over the properties, production and applications of various ferro alloy materials)

UNIT-I

(Learning objective: To obtain knowledge over the importance of ferro alloys and present status of ferro alloys in India)

Introduction: Types of Ferro alloys and their uses: Present status of ferroalloy industry in India. Future plans and developments.

UNIT-II

(Learning objective: To obtain knowledge over the ferro alloy production and the physico chemical aspects involved)

Principles: Physicochemical aspects of ferroalloys. Production by various methods.

UNIT-III

(Learning objective: To study and learn about various furnaces used for production of ferro alloys)

Furance types and its design, refractories, auxiliaries, power supply. Working voltage, power factor and efficiency.

UNIT-IV

(Learning objective: To study and learn about various production methods of ferro alloys)

Production: Production of ferro-silicon-calcium, ferromanganese (high and low carbon), Ferro-chrome(high and low carbon),Ferro-molybdenum.

UNIT-V

(Learning objective: To study in detail about the production of ferro tungsten, ferro titanium and ferro vanadium)

Ferro-tungstun,ferro-titanium,ferro-vanadium.

UNIT-VI

(Learning objective: To study in detail about the ferro alloy plant lay out)

Lay out: Lay out of a ferro alloy plant and its production economics.

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (With a focus on academically weak students) at the end of each unit.)

Text Books

1. A. Riss and Y. Khodorovsky , Production ferroalloys Mir Publishers,Moscow 1967.
2. B. P. Bharadwaj, The complete book on ferroalloys, NIIR Project consultancy services, 2014

References

1. Hand book of Ferro alloys: theory and technology Edited by Michael Gasik, BH publishers, 2013

IV Year – II Semester

L	T	P	C
4	0	0	3

NANO-MATERIALS

(Objectives: The course conveys the basic concepts relevant to nano material properties, synthesis, characterization and applications)

UNIT-I

(Learning Objectives: To understand the basic concepts of quantum mechanics and other fundamentals relevant to spectroscopy)

General Introduction: Basics of Quantum Mechanics, Harmonic oscillator, magnetic Phenomena, band structure in solids, optical phenomena bonding in solids, Anisotropy.

UNIT-II

(Learning Objectives: To understand the synthesis and characterization of nano SiC, alumina and Zirconia)

Nano particles of Silicon Carbide, Alumina and Zirconia: nano materials preparation, Sintering, X-ray Diffraction analysis, electron microscopy and applications.

UNIT-III

(Learning Objectives: To study the mechanical and optical properties of various nano crystalline materials)

Mechanical Properties: Strength of nano crystalline SiC, Preparation for strength measurements, Mechanical properties, Magnetic properties,

Electrical Properties: Switching glasses with nanoparticles,Electronic conduction with nano particles

Optical Properties: Optical properties, special properties and the coloured glasses

UNIT-IV

(Learning Objectives: To understand and to be acquainted with various methods of synthesizing nano powders)

Process of synthesis of nano powders, Electro deposition, Important nano materials

UNIT-V

(Learning Objectives: To understand various characterization techniques of nano materials)

Investigating and manipulating materials in the nanoscale: Electron microscopics, scanning probe microscopics, optical microscopics for nano science and technology, X-ray diffraction.

UNIT-VI

(Learning Objectives: To obtain knowledge over properties, analysis and applications of nano bio-molecules and bio-particles)

Nanobiology : Interaction between bimolecules and naoparticle surface, Different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, Application of nano in biology, nanoprobes for Analytical Applications-A new Methodology in medical diagnostics and Biotechnology, Current status of nano Biotechnology, Future perspectives of Nanobiology, Nanosensors.

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (With a focus on academically weak students) at the end of each unit.)

Text Books

1. Textbook of nanoscience and nanotechnology, B.S. Murty et al. Universities Press, IIM series, 2012
2. Nano: the essentials- T.Pradeep, Tata McGrawHill Publishers, 2007

References:

Introduction to nanotechnology, Charles P. Poole, Wiley publishers, 2003

IV Year – II Semester

L	T	P	C
4	0	0	3

SURFACE ENGINEERING
(ELECTIVE-III)

Objective: To impart knowledge on surface degradation, surface characterisation techniques and surface modification methods.

UNIT-I

(Learning objective:To understand various surface degradation phenomena)

Introduction tribology, surface degradation, wear and corrosion, types of wear, adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication- overview of different forms of corrosion.

UNIT-II

(Learning objective: To explore different surface electrochemical reactions)

Chemical and electrochemical polishing, significance, specific examples, chemical conversion coatings, phosphating, chromating, chemical colouring, anodizing of aluminium alloys, thermochemical processes -industrial practices.

UNIT-III

(Learning objective:To learn different electrochemical coating methods)

Surface pre-treatment, deposition of copper, zinc, nickel and chromium - principles and practices, alloy plating, electrocomposite plating, properties of electro deposits, electroless, electroless composite plating; application areas, properties.

UNIT-IV

(Learning objective: To understand different physical coating methods)

Definitions and concepts, physical vapour deposition (PVD), evaporation, sputtering, ion plating, plasma nitriding, process capabilities, chemical vapour deposition (CVD), metal organic CVD, plasma assisted CVD.

UNIT-V

(Learning objective: To understand different thermal spray coatings)

Thermal spraying, techniques, advanced spraying techniques - plasma surfacing, detonation gun and high velocity oxy-fuel processes

UNIT-VI

(Learning objective: To understand various surface laser techniques)

Llaser surface alloying, laser cladding, specific industrial applications, tests for assessment of wear and corrosion

Text Books

1. *Sudarshan T S, 'Surface modification technologies - An Engineer's guide', Marcel Dekker, Newyork, 1989*
2. *Varghese C.D, 'Electroplating and Other Surface Treatments - A Practical Guide', TMH, 1993*

References

1. Surface engineering ASM Handbook, Vol. 5

IV Year – II Semester

L	T	P	C
4	0	0	3

LADLE METALLURGY & CONTINUOUS CASTING (ELECTIVE-III)

Course objective: *To study ladle and continuous casting of steels, ladle metallurgy, ingot metallurgy and advantages of continuous casting*

UNIT I
(Learning Objectives: To understand the terminology used in ladle & continuous cast metallurgy.)

Introduction – scrap based operation Vs refining ; trends in quality of liquid steel; different approaches to refining.

UNIT II
(Learning Objectives: To classify different kinds of treatments during steel production)

Overview of various treatments including vacuum, inert gas, injection, electro-slag.

UNIT III
(Learning Objectives: To understand advantages of refining of steel)

Introduction related to injection metallurgy; Ladle furnace; advantages and approaches; injectibles – type of materials; discussion of some specific treatments; impact on overall quality; foaming of slags.

UNIT IV
(Learning Objectives: To analyse the advantages of ladle metallurgy)

Ingot casting Vs continuous casting (CC) ; difficulties in CC of steels; increasing CC output in the steel industry; mould and machine details including different components and configurations; SEN, Ladle and Tundish.

UNIT V
(Learning Objectives: To compare capabilities of ingot metallurgy and ladle metallurgy)

Role of mould powders (fluxes) in CC; physical and chemical interactions during CC; overview of defects in CC

UNIT VI
(Learning Objectives: To know various fluxes in continuous casting and their advantages)

Production stoppages such as breakouts; indicative heat sizes and machine output; concept and implementation of sequence casting.

Text Books
1. Tupkary R.H., “Introduction to Modern Steel Making”, Khanna Publishers, 2004
2. A. Ghosh, Secondary steel making, CRC press, 2000

References

1. Continuous Casting– Vol.1, Chemical and Physical Interactions during transfer operations, Iron and Steel Society, Warrendale, PA, USA, 1983.
2. B.Deo, R. Boom, “Fundamentals of steel making metallurgy”, Prentice Hall International, New York, 1993

IV Year – II Semester

L	T	P	C
4	0	0	3

INDUSTRIAL TRIBOLOGY
(ELECTIVE-III)

(Course Objective: To get knowledge on lubrication system, frictional aspects and other tribological matters pertaining to industrial applications)

UNIT – I

(Learning Objective: To study the fundamental concepts of viscosity and different viscometers)

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation -absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers used.

UNIT – II

(Learning Objective: To study and learn about hydrostatic lubrication system)

Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

UNIT – III

(Learning Objective: To understand and learn the concepts of hydrodynamic theory of lubrication)

Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing.

UNIT – IV

(Learning Objective: To understand the mechanism and causes of friction and power losses in journal bearings)

Friction and Power Losses in Journal Bearings and its Applications: Calibration of friction loss friction in concentric bearings, bearing moduIus, Sommerfield number, heat balance, practical consideration of journal bearing considerations. Study of current concepts of boundary friction and dry friction.

UNIT – V

(Learning Objective: To study and learn about importance of air lubricated bearings)

Air lubricated bearing: Advantages and disadvantages application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect.

UNIT - VI

(Learning Objective: To study and learn about the various types of bearing materials and bearing oil pads)

Types of bearing materials and bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. General requirements of bearing materials, types of bearing materials.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested periodically in classes. Unit tests are to be conducted at the end of each unit).

Text Books

1. Introduction to tribology, Bharart Bhushan, John-Wiley, 2002
2. Fundamentals of Tribology, S. K. Basu, S. N. SenGupta and B. B. Ahuja, PHI Learning, 2005

Reference

1. Industrial tribology, Theo Mang et al. Wiley-VCH, 2011
2. Friction, lubrication and wear technology, ASM Hand book, Vol. 18, 1992

SEMINAR – 2 Credits

PROJECT – 10 Credits