ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABUS

METALLURGICAL ENGINEERING

For

METALLURGICAL ENGINEERING FOUR DEGREE COURSE

(Applicable for batches admitted from 2013-2014)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA - 533 003, Andhra Pradesh, India

COURSE STRUCTURE

I Year – I SEMESTER

S. No.	Subject	T	P	Credits
1	English – I	3+1	--	3
2	Mathematics - I	3+1	--	3
3	Engineering Chemistry	3+1	--	3
4	Engineering Mechanics	3+1	--	3
5	Computer Programming	3+1	--	3
6	Environmental Studies	3+1	--	3
7	Engineering Chemistry Laboratory	--	3	2
8	English - Communication Skills Lab - I	--	3	2
9	C Programming Lab	--	3	2
Total Credits				**24**

I Year – II SEMESTER

S. No.	Subject	T	P	Credits
1	English – II	3+1	--	3
2	Mathematics – II (Mathematical Methods)	3+1	--	3
3	Mathematics – III	3+1	--	3
4	Engineering Physics	3+1	--	3
5	Professional Ethics and Human Values	3+1	--	3
6	Engineering Drawing	3+1	--	3
7	English - Communication Skills Lab - II	--	3	2
8	Engineering Physics Lab	--	3	2
9	Engineering Physics – Virtual Labs - Assignments	--	2	--
10	Engg.Workshop & IT Workshop	--	3	2
Total Credits				**24**

II Year – I SEMESTER

S. No.	Subject	T	P	Credits
1	Physical Metallurgy	4	--	3
2	Mechanics of Solids	4	--	3
3	Mechanics of Fluids	4	--	3
4	Managerial Economics and Financial Analysis	4	--	3
5	Thermodynamics & Kinetics	4	--	3
6	Elements of Mechanical Engineering	4	--	3
7	Physical Metallurgy Lab	--	3	2
8	Mechanics of Solids Lab	--	3	2
Total Credits				**22**

II Year – II SEMESTER

S. No.	Subject	T	P	Credits
1	Mineral Dressing	4	--	3
2	Instrumentation	4	--	3
3	Metallurgical Analysis	4	--	3
4	Principles of Extractive Metallurgy	4	--	3
5	Electrical & Electronics Engineering	4	--	3
6	Metallurgical Thermodynamics	4	--	3
7	Metallurgical Analysis Lab	--	3	2
8	Mineral Dressing Lab	--	3	2
Total Credits				**22**

III Year – I SEMESTER

S. No.	Subject	T	P	Credits
1	Industrial Management	4	-	3
2	Material Characterization Techniques	4	-	3
3	Fuels, Furnaces and Refractories	4	-	3
4	Foundry Technology	4	-	3
5	Iron Production	4	-	3
6	Non Ferrous Extractive Metallurgy	4	-	3
7	Fuels, Furnaces and Refractories Lab	-	3	2
8	Foundry Technology Lab	-	3	2
Total Credits				**22**

III Year – II SEMESTER

S. No.	Subject	T	P	Credits
1	Composites	4	-	3
2	Steel Making	4	-	3
3	Mechanical Metallurgy	4	-	3
4	Welding Technology	4	-	3
5	Heat Treatment Technology	4	-	3
6	Welding Technology Lab	-	3	2
7	Heat Treatment Technology Lab	-	3	2
8	Mechanical Metallurgy Lab	-	3	2
Total Credits				**21**

IV Year – I SEMESTER

S. No.	Subject	T	P	Credits
1	Metal forming and press tools	4	-	3
2	Electro Metallurgy and Corrosion	4	-	3
3	Computer applications in Metallurgy and Materials	4	-	3
4	Powder Metallurgy	4	-	3
5	**Open Elective** 1. Non–Conventional Sources of Energy 2. Industrial Tribology 3. Super alloys	4	-	3
6	**Elective-I** 1. Light Metals and Alloys 2. Metallurgical Problems 3. Fracture Mechanics	4	-	3
7	Metal forming and press tools Lab	-	3	2
8	Electro Metallurgy and Corrosion Lab	-	3	2
Total Credits				**22**

IV Year – II SEMESTER

S. No.	Subject	T	P	Credits
1	Nano Materials	4	-	3
2	**Elective-II** 1. CAD/CAM 2. Semiconductors and Magnetic Materials 3. Ceramic Science and Technology	4	-	3
3	**Elective-III** 1. Experimental Techniques in Metallography 2. Plasticity and Plastic deformation 3. Tool Steels	4	-	3
4	**Elective-IV** 1. Nuclear Metallurgy 2. Ferro Alloy Technology 3. Polymeric Materials	4	-	3
5	Non-Destructive Testing Lab		3	2
6	Project			09
Total Credits				**21**

SYLLABUS

I Year – I SEMESTER	T	P	C
	3+1	0	3

ENGLISH –I
(Common to All Branches)

DETAILED TEXT-I English Essentials : Recommended Topics :

1. **IN LONDON: M.K.GANDHI**
   OBJECTIVE: To apprise the learner how Gandhi spent a period of three years in London as a student.
   OUTCOME: The learner will understand how Gandhi grew in introspection and maturity.
2. **THE KNOWLEDGE SOCIETY- APJ KALAM**
   OBJECTIVE: To make the learners rediscover India as a land of Knowledge.
   OUTCOME: The learners will achieve a higher quality of life, strength and sovereignty of a developed nation.
3. **THE SCIENTIFIC POINT OF VIEW- J.B.S. HALDANE**
   OBJECTIVE: This essay discusses how scientific point of view seeks to arrive at the truth without being biased by emotion.
   OUTCOME: This develops in the student the scientific attitude to solve many problems which we find difficult to tackle.
4. **PRINCIPLES OF GOOD WRITING:**
   OBJECTIVE: To inform the learners how to write clearly and logically.
   OUTCOME: The learner will be able to think clearly and logically and write clearly and logically.
5. **MAN'S PERIL**
   OBJECTIVE: To inform the learner that all men are in peril.
   OUTCOME: The learner will understand that all men can come together and avert the peril.
6. **THE DYING SUN—SIR JAMES JEANS**
   OBJECTIVE: This excerpt from the book "The Mysterious Universe" presents the mysterious nature of the Universe and the stars which present numerous problems to the scientific mind. Sir James Jeans uses a poetic approach to discuss the scientific phenomena.
   OUTCOME: This provides the students to think about the scientific phenomena from a different angle and also exposes the readers to poetic expressions.
7. **LUCK—MARK TWAIN**
   OBJECTIVE: This is a short story about a man's public image and his true nature. The theme of the story is that luck can be a factor of life, so that even if one is incompetent but lucky, one can still succeed.
   OUTCOME: The story is humourous in that it contains a lot of irony. Thus this develops in the learner understand humourous texts and use of words for irony.

Text Book : 'English Essentials' by Ravindra Publications

NON-DETAILED TEXT:

(From Modern Trailblazers of Orient Blackswan)
(Common single Text book for two semesters)
(Semester I (1 to 4 lessons)/ Semester II (5 to 8 lessons)

1. **G.D.Naidu**
   OBJECTIVE: To inspire the learners by G.D.Naidu's example of inventions and contributions.
   OUTCOME: The learner will be in a position to emulate G.D.Naidu and take to practical applications.
2. **G.R.Gopinath**
   OBJECTIVE: To inspire the learners by his example of inventions.
   OUTCOME: Like G.R.Gopinath, the learners will be able to achieve much at a low cost and help the common man.
3. **Sudhamurthy**
   OBJECTIVE: To inspire the learners by the unique interests and contributions of Sudha Murthy.
   OUTCOME: The learner will take interest in multiple fields of knowledge and make life worthwhile through social service.
4. **Vijay Bhatkar**
   OBJECTIVE: To inspire the learner by his work and studies in different fields of engineering and science.
   OUTCOME: The learner will emulate him and produce memorable things.

Text Book : 'Trail Blazers' by Orient Black Swan Pvt. Ltd. Publishers

I Year – I SEMESTER

T	P	C
3+1	0	3

MATHEMATICS – I (DIFFERENTIAL EQUATIONS)
(Common to All Branches)

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.
Subject Category
ABET Learning Objectives a d e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

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).
Applications: LCR circuit, Simple Harmonic motion
Subject Category
ABET Learning Objectives a d e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT III Laplace transforms:
Laplace transforms of standard functions-ShiftingTheorems, Transforms of derivatives and integrals – Unit step function –Dirac's delta function- Inverse Laplace transforms– Convolution theorem (with out proof).
Application: Solutions of ordinary differential equations using Laplace transforms.
Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT IV Partial differentiation:
Introduction- Total derivative-Chain rule-Generalized Mean Value theorem for single variable (without proof)-Taylors and Mc Laurent's series for two variables– Functional dependence- Jacobian.
Applications: Maxima and Minima of functions of two variables with constraints and without constraints.
Subject Category
ABET Learning Objectives a c e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

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 type) equations
Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT VI Higher order Partial differential equations:
Solutions of Linear Partial differential equations with constant coefficients- Method of separation of Variables
Applications: One- dimensional Wave, Heat equations - two-dimensional Laplace Equation.
Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation B E

Books:

1. **B.S.GREWAL,** Higher Engineering Mathematics, 42nd Edition, Khanna Publishers
2. **ERWIN KREYSZIG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
3. **GREENBERG,** Advanced Engineering Mathematics, 2nd edition, Pearson edn
4. **DEAN G. DUFFY,** Advanced engineering mathematics with MATLAB, CRC Press
5. **PETER O'NEIL,** advanced Engineering Mathematics, Cengage Learning.

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	a) Apply knowledge of math, science, & engineering b) Design & conduct experiments, analyze & interpret data c) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints d) Function on multidisciplinary teams e) Identify, formulate, & solve engineering problems f) Understand professional & ethical responsibilities g) Communicate effectively h) Understand impact of engineering solutions in global, economic, environmental, & societal context i) Recognize need for & be able to engage in lifelong learning j) Know contemporary issues k) Use techniques, skills, modern tools for engineering practices	1. Objective tests 2. Essay questions tests 3. Peer tutoring based 4. Simulation based 5. Design oriented 6. Problem based 7. Experiential (project based) based 8. Lab work or field work based 9. Presentation based 10. Case Studies based 11. Role-play based 12. Portfolio based	A. Questions should have: B. Definitions, Principle of operation or philosophy of concept. C. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. D. Design oriented problems E. Trouble shooting type of questions F. Applications related questions G. Brain storming questions	

I Year – I SEMESTER

T	P	C
3+1	0	3

ENGINEERING CHEMISTRY

UNIT-I: WATER TECHNOLOGY

Hard Water – Estimation of hardness by EDTA method – Potable water- Sterilization and Disinfection – Boiler feed water – Boiler troubles – Priming and foaming , scale formation, corrosion, caustic embrittlement, turbine deposits – Softening of water – Lime soda, Zeolite processes – Reverse osmosis – Electro Dialysis, Ion exchange process

Objectives : For prospective engineers knowledge about water used in industries (boilers etc.) and for drinking purposes is useful; hence chemistry of hard water, boiler troubles and modern methods of softening hard water is introduced.

UNIT-II : ELECTROCHEMISTRY

Concept of Ionic conductance – Ionic Mobilities – Applications of Kohlrausch law – Conductometric titrations – Galvanic cells – Electrode potentials – Nernst equation – Electrochemical series – Potentiometric titrations – Concentration cells – Ion selective electrode –Glass electrodes – Fluoride electrode; Batteries and Fuel cells

Objectives : Knowledge of galvanic cells, electrode potentials, concentration cells is necessary for engineers to understand corrosion problem and its control ; also this knowledge helps in understanding modern bio-sensors, fuel cells and improve them.

UNIT-III : CORROSION

Causes and effects of corrosion – theories of corrosion (dry, chemical and electrochemical corrosion) – Factors affecting corrosion – Corrosion control methods – Cathodic protection –Sacrificial Anodic, Impressed current methods – Surface coatings – Methods of application on metals (Hot dipping, Galvanizing, tinning , Cladding, Electroplating, Electroless plating) – Organic surface coatings – Paints – Their constituents and their functions.

Objectives : the problems associated with corrosion are well known and the engineers must be aware of these problems and also how to counter them

UNIT-IV : HIGH POLYMERS

Types of Polymerization – Stereo regular Polymers – Physical and Mechanical properties of polymers – Plastics – Thermoplastics and thermo setting plastics – Compounding and Fabrication of plastics – Preparation and properties of Polyethylene, PVC and Bakelite – Elastomers – Rubber and Vulcanization – Synthetic rubbers – Styrene butadiene rubber – Thiokol – applications.

Objectives : Plastics are materials used very widely as engineering materials. An understanding of properties particularly physical and mechanical properties of polymers / plastics / elastomers helps in selecting suitable materials for different purposes.

UNIT-V : FUELS

Coal – Proximate and ultimate analysis – Numerical problems based on analysis – Calorific vaule – HCV and LCV – Problems based on calorific values; petroleum – Refining – Cracking – Petrol – Diesel knocking; Gaseous fuels – Natural gas – LPG, CNG – Combustion – Problems on air requirements.

Objectives : A board understanding of the more important fuels employed on a large scale is necessary for all engineer to understand energy – related problems and solve them.

UNIT-VI : CHEMISTRY OF ADVANCED MATERIALS

Nanometerials (Preparation of carbon nanotubes and fullerenes – Properties of nanomaterials – Engineering applications) – Liquid crystals (Types – Application in LCD and Engineering Applications) – Fiber reinforced plastics – Biodegradable polymers – Conducting polymers – Solar cells (Solar heaters – Photo voltaic cells – Solar reflectors – Green house concepts – Green chemistry (Methods for green synthesis and Applications) – Cement – Hardening and setting – Deterioration of cement concrete

Objectives : With the knowledge available now, future engineers should know at least some of the advanced materials that are becoming available. Hence some of them are introduced here.

TEXT BOOKSS

1. Jain and Jain (Latest Edition), Engineering Chemistry, Dhanpat Rai Publishing company Ltd,
2. N.Y.S.Murthy, V.Anuradha, KRamaRao "A Text Book of Engineering Chemistry", Maruthi Publications
3. C.Parameswara Murthy, C.V.Agarwal, Adhra Naidu (2006) Text Book of Engineering Chemistry, B.S.Publications
4. B.Sivasankar (2010), Engineering Chemistry, McGraw-Hill companies.
5. Ch.Venkata Ramana Reddy and Ramadevi (2013) , Engineering Chemistry, Cengage Learning

REFENCE BOOKSS

1. S.S. Dara (2013) Text Book of Engineering Chemistry, S.Chand Technical Series
2. K.Sesha Maheswaramma and Mridula Chugh (2013), Engineering Chemistry, Pearson Publications.
3. R.Gopalan, D.Venkatappayya, Sulochana Nagarajan (2011), Text Book of Engineering Chemistry, Vikas Publications.
4. B.Viswanathan and M.Aulice Scibioh (2009), Fuel Cells, Principals and applications, University Press.

I Year – I SEMESTER

T	P	C
3+1	0	3

ENGINEERING 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.

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 basis principles), centre of gravity of composite bodies, pappus theorem.

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.

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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.
2. Engineering Mechanics: Statics and Dynamics 3rd edition, Andrew Pytel and Jaan Kiusalaas; Cengage Learning publishers.

REFENCE BOOKSS:

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 , dynamics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
4. Engineering Mechanics , statics and dynamics – I.H.Shames, – Pearson Publ.
5. Mechanics For Engineers , statics - F.P.Beer & E.R.Johnston – 5th Edn Mc Graw Hill Publ.
6. Mechanics For Engineers, dynamics - F.P.Beer & E.R.Johnston – 5th Edn Mc Graw Hill Publ.
7. 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.
8. Engineering Mechanics , Fedinand . L. Singer , Harper – Collins.
9. Engineering Mechanics statics and dynamics , A Nelson, Mc Graw Hill publications
10. Engineering Mechanics, Tayal. Umesh Publ.

1 Year – I SEMESTER	T	P	C
	3+1	0	3

COMPUTER PROGRAMMING

Objectives: Formulating algorithmic solutions to problems and implementing algorithms in C

UNIT I:
Unit objective: Notion of Operation of a CPU, Notion of an algorithm and computational procedure, editing and executing programs in Linux
Introduction: Computer systems, Hardware and Software Concepts**,**
Problem Solving: Algorithm / Pseudo code, flowchart, program development steps, computer languages: machine, symbolic and highlevel languages, Creating and Running Programs: Writing, Editing(vi/emacs editor), Compiling(gcc), Linking and Executing in under Linux.
BASICS OF C: Structure of a C program, identifiers, basic data types and sizes. Constants, Variables, Arthmetic , relational and logical operators, increment and decrement operators, conditional operator, assignment operator, expressions, type conversions, Conditional Expressions, precedence and order of evaluation, Sample Programs.

UNIT II:
Unit objective: understanding branching, iteration and data representation using arrays
SELECTION – MAKING DECISION: TWO WAY SELECTION: if-else, null else, nested if, examples, Multi-way selection: switch, else-if, examples**.**
ITERATIVE: loops- while, do-while and for statements , break, continue, initialization and updating, event and counter controlled loops, Looping applications: Summation, powers, smallest and largest.
ARRAYS: Arrays- concepts, declaration, definition, accessing elements, storing elements, Strings and String Manipulations, 1-D arrays, 2-D arrays and character arrays, string manipulations, Multidimensional arrays, array applications: Matrix operations, checking the symmetricity of a Matrix**.**
STRINGS: concepts, c strings.

UNIT III:
Objective: Modular programming and recursive solution formulation
FUNCTIONS- MODULAR PROGRAMMING: functions, basics, parameter passing, storage classes extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, Recursive solutions for fibonacci series, towers of Hanoi, header files, C Preprocessor, example c programs, Passing 1-D arrays, 2-D arrays to functions.

UNIT IV:
Objective: Understanding pointers and dynamic memory allocation
POINTERS: pointers- concepts, initialization of pointer variables, pointers and function arguments, passing by address- dangling memory, address arithmetic, character pointers and functions, pointers to pointers, pointers and multi-dimensional arrays, dynamic memory management functions, command line arguments

UNIT V:
Objective: Understanding miscellaneous aspects of C
ENUMERATED, STRUCTURE AND UNION TYPES: Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit-fields, program applications
BIT-WISE OPERATORS: logical, shift, rotation, masks.

UNIT VI:
Objective: Comprehension of file operations
FILE HANDLING: Input and output- concept of a file, text files and binary files, Formatted I/O, File I/O operations, example programs

Text Books:

1. Problem Solving and Program Design in C, Hanly, Koffman, 7th ed, PERSON
2. Programming in C, Second Edition Pradip Dey and Manas Ghosh, OXFORD Higher Education
3. Programming in C, A practical approach Ajay Mittal PEARSON
4. The C programming Language by Dennis Richie and Brian Kernighan
5. Programming in C, B. L. Juneja, Anith Seth, Cengage Learning.

Reference Books and web links:

1. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, 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

T	P	C
3+1	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.

Solid Waste Management: Sources, classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products.

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

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

Text Books:

1. Environmental Studies by R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
2. A Textbook of Environmental Studies by Shaashi Chawla, TMH, New Delhi
3. Environmental Studies by P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

REFENCE BOOKS:

1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada
3. Environmental Studies by Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Environmental Studies by Piyush Malaviya, Pratibha Singh, Anoop singh: Acme Learning, New Delhi

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I Year – I SEMESTER

T	P	C
0	3	2

ENGINEERING CHEMISTRY LABORATORY

List of Experiments

1. Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Quantitative analysis etc.,
2. Trial experiment – Estimation of HCI using standard Na_2co_3 solutions
3. Estimation of $KMnO_4$ using standard Oxalic acid solution.
4. Estimation of Ferric iron using standard $K_2Cr_2O_7$ solution.
5. Estimation of Copper using standard $K_2Cr_2O_7$ solution.
6. Estimation of Total Hardness water using standard EDTA solution.
7. Estimation of Copper using standard EDTA solution.
8. Estimation of Copper using Colorimeter
9. Estimation of pH of the given sample solution using pH meter.
10. Conductometric Titrations between strong acid and strong base
11. Conductometric Titrations between strong acid and Weak base
12. Potentiometric Titrations between strong acid and strong base
13. Potentiometric Titrations between strong acid and Weak base
14. Estimatinog of Zinc using standard potassium ferrocyanide solution
15. Estimation of Vitamin – C

TEXT BOOKSS

1. Dr.Jyotsna Cherukuis(2012)Laboratory Manual of Engineering Chemistry-II, VGS Techno Series
2. Chemistry Practical Manual, Lorven Publications
3. K. Mukkanti (2009) Practical Engineering Chemistry, B.S.Publication

I Year – I SEMESTER

T	P	C
0	3	2

ENGLISH – COMMUNICATION SKILLS LAB – I

Suggested Lab Manuals:

OBJECTIVE: To impart to the learner the skills of grammar as well as communication through listening, speaking, reading, and writing including soft, that is life skills.

BASIC COMMUNICATION SKILLS

UNIT 1	A. Greeting and Introductions
	B. Pure Vowels
UNIT 2	A. Asking for information and Requests
	B. Diphthongs
UNIT 3	A. Invitations
	B. Consonants
UNIT 4	A. Commands and Instructions
	B. Accent and Rhythm
UNIT 5	A. Suggestions and Opinions
	B. Intonation

Text Book:

'Strengthen your Communication Skills' Part-A by Maruthi Publications

Reference Books:

1. INFOTECH English (Maruthi Publications)
2. Personality Development and Soft Skills (Oxford University Press, New Delhi)

I Year – I SEMESTER

T	P	C
0	3	2

C PROGRAMMING LAB

Exercise 1

a) Write a C Program to calculate the area of triangle using the formula
area = (s (s-a) (s-b)(s-c))$^{1/2}$ where s= (a+b+c)/2

b) Write a C program to find the largest of three numbers using ternary operator.

c) Write a C Program to swap two numbers without using a temporary variable.

Exercise 2

a) 2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.

b) Write a C program to find the roots of a quadratic equation.

c) Write a C program, which takes two integer operands and one operator form the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

Exercise 3

a) Write a C program to find the sum of individual digits of a positive integer and find the reverse of the given number.

b) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the

c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Exercise 4

a) Write a C Program to print the multiplication table of a given number n up to a given value, where n is entered by the user.

b) Write a C Program to enter a decimal number, and calculate and display the binary equivalent of that number.

c) Write a C Program to check whether the given number is Armstrong number or not.

Exercise 5

a) Write a C program to interchange the largest and smallest numbers in the array.

b) Write a C program to implement a liner search.

c) Write a C program to implement binary search

Exercise 6

a) Write a C program to implement sorting of an array of elements .

b) Write a C program to input two m x n matrices, check the compatibility and perform addition and multiplication of them

Exercise 7

Write a C program that uses functions to perform the following operations:

i. To insert a sub-string in to given main string from a given position.
ii. To delete n Characters from a given position in a given string.
iii. To replace a character of string either from beginning or ending or at a specified location

Exercise 8

Write a C program that uses functions to perform the following operations using Structure:

i) Reading a complex number
ii) Writing a complex number
iii) Addition of two complex numbers
iv) Multiplication of two complex numbers

Exercise 9

Write C Programs for the following string operations without using the built in functions

- to concatenate two strings
- to append a string to another string
- to compare two strings

Exercise 10

Write C Programs for the following string operations without using the built in functions

- to find t he length of a string
- to find whether a given string is palindrome or not

Exercise 11

a) Write a C functions to find both the largest and smallest number of an array of integers.

b) Write C programs illustrating call by value and call by reference cncepts.

Exercise 12

Write C programs that use both recursive and non-recursive functions for the following

i) To find the factorial of a given integer.

ii) To find the GCD (greatest common divisor) of two given integers.

iii) To find Fibonacci sequence

Exercise 13

a) Write C Program to reverse a string using pointers

b) Write a C Program to compare two arrays using pointers

Exercise 14

a) Write a C program consisting of Pointer based function to exchange value of two integers using passing by address.

b) Write a C program to swap two numbers using pointers

Exercise 15

Examples which explores the use of structures, union and other user defined variables

Exercise 16

a) Write a C program which copies one file to another.

b) Write a C program to count the number of characters and number of lines in a file.

c) Write a C Program to merge two files into a third file. The names of the files must be entered using command line arguments.

I Year – II SEMESTER

T	P	C
3+1	0	3

ENGLISH –II
(Common to All Branches)

DETAILED TEXT-II : Sure Outcomes: English for Engineers and Technologists **Recommended Topics :**

1. **TECHNOLOGY WITH A HUMAN FACE**
   OBJECTIVE: To make the learner understand how modern life has been shaped by technology.
   OUTCOME: The proposed technology is people's technology. It serves the human person instead of making him the servant of machines.
2. **CLIMATE CHANGE AND HUMAN STRATEGY**
   OBJECTIVE: To make the learner understand how the unequal heating of earth's surface by the Sun, an atmospheric circulation pattern is developed and maintained.
   OUTCOME: The learner's understand that climate must be preserved.
3. **EMERGING TECHNOLOGIES**
   OBJECTIVE: To introduce the technologies of the 20th century and 21st centuries to the learners.
   OUTCOME: The learner will adopt the applications of modern technologies such as nanotechnology.
4. **WATER- THE ELIXIR OF LIFE**
   OBJECTIVE: To inform the learner of the various advantages and characteristics of water.
   OUTCOME: The learners will understand that water is the elixir of life.
5. **THE SECRET OF WORK**
   OBJECTIVE:: In this lesson, Swami Vivekananda highlights the importance of work for any development.
   OUTCOME: The students will learn to work hard with devotion and dedication.
6. **WORK BRINGS SOLACE**
   OBJECTIVE: In this lesson Abdul Kalam highlights the advantage of work.
   OUTCOME: The students will understand the advantages of work. They will overcome their personal problems and address themselves to national and other problems.

Text Book : 'Sure Outcomes' by Orient Black Swan Pvt. Ltd. Publishers

NON-DETAILED TEXT:

(From Modern Trailblazers of Orient Blackswan)
(Common single Text book for two semesters)
(Semester I (1 to 4 lessons)/ Semester II (5 to 8 lessons)

5. **J.C. Bose**
   OBJECTIVE: To apprise of J.C.Bose's original contributions.
   OUTCOME: The learner will be inspired by Bose's achievements so that he may start his own original work.
6. **Homi Jehangir Bhaba**
   OBJECTIVE: To show Bhabha as the originator of nuclear experiments in India.
   OUTCOME: The learner will be inspired by Bhabha's achievements so as to make his own experiments.
7. **Vikram Sarabhai**
   OBJECTIVE: To inform the learner of the pioneering experiments conducted by Sarabhai in nuclear energy and relevance of space programmes.
   OUTCOME: The learner will realize that development is impossible without scientific research.
8. **A Shadow- R.K.Narayan**
   OBJECTIVE: To expose the reader to the pleasure of the humorous story
   OUTCOME: The learner will be in a position to appreciate the art of writing a short story and try his hand at it.

Text Book : 'Trail Blazers' by Orient Black Swan Pvt. Ltd. Publishers

I Year – II SEMESTER

T	P	C
3+1	0	3

MATHEMATICS – II
(MATHEMATICAL METHODS)

(Common to All Branches)

UNIT I Solution of Algebraic and Transcendental Equations:

Introduction- Bisection Method – Method of False Position – Iteration Method – Newton-Raphson Method (One variable and Simultaneous Equestions)

Subject Category
ABET Learning Objectives a e k
ABET internal assessments 1 2 4 6
JNTUK External Evaluation A B E

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 unevenly spaced points - Lagrange's Interpolation formula

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 4 6
JNTUK External Evaluation A B E

UNIT III Numerical solution of Ordinary Differential equations:

Solution by Taylor's series-Picard's Method of successive Approximations-Euler's Method-Runge-Kutta Methods

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 4 6
JNTUK External Evaluation A B E

UNIT IV Fourier Series:

Introduction- Determination of Fourier coefficients – even and odd functions –change of interval– Half-range sine and cosine series
application: Amplitude, spectrum of a periodic function

Subject Category
ABET Learning Objectives a e d
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT V Fourier Transforms:

Fourier integral theorem (only statement) – Fourier sine and cosine integrals - sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms

Subject Category
ABET Learning Objectives a d e k
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT VI Z-transform:

Introduction– properties – Damping rule – Shifting rule – Initial and final value theorems -Inverse z transform- -Convolution theorem – Solution of difference equation by Z -transforms.

Subject Category
ABET Learning Objectives a b e k
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

BOOKS:

1. **B.S. GREWAL,** Higher Engineering Mathematics, 42nd Edition, Khanna Publishers
2. **DEAN G. DUFFY,** Advanced Engineering Mathematics with MATLAB, CRC Press
3. **V.RAVINDRANATH and P. VIJAYALAXMI,** Mathematical Methods, Himalaya Publishing House
4. **ERWYN KREYSZIG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	a) Apply knowledge of math, science, & engineering b) Design & conduct experiments, analyze & interpret data c) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints d) Function on multidisciplinary teams e) Identify, formulate, & solve engineering problems f) Understand professional & ethical responsibilities g) Communicate effectively h) Understand impact of engineering solutions in global, economic, environmental, & societal context i) Recognize need for & be able to engage in lifelong learning j) Know contemporary issues k) Use techniques, skills, modern tools for engineering practices	1. Objective tests 2. Essay questions tests 3. Peer tutoring based 4. Simulation based 5. Design oriented 6. Problem based 7. Experiential (project based) based 8. Lab work or field work based 9. Presentation based 10. Case Studies based 11. Role-play based 12. Portfolio based	A. Questions should have: B. Definitions, Principle of operation or philosophy of concept. C. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. D. Design oriented problems E. Trouble shooting type of questions F. Applications related questions G. Brain storming questions	

I Year – II SEMESTER

T	P	C
3+1	0	3

MATHEMATICS – III
(LINEAR ALGEBRA & VECTOR CALCULUS)
(Common to All Branches)

UNIT I Linear systems of equations:
Rank-Echelon form, Normal form – Solution of Linear Systems – Direct Methods- Gauss Elimination - Gauss Jordon and Gauss Seidal Methods.
Application: Finding the current in a electrical circuit.
Subject Category
ABET Learning Objectives a e k
ABET internal assessments 1 2 6 4
JNTUK External Evaluation A B E

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- Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, negative definite - semi definite - index – signature.
Application: Free vibration of a two-mass system.
Subject Category
ABET Learning Objectives a d e k
ABET internal assessments 1 2 4 6
JNTUK External Evaluation A B E

UNIT III Multiple integrals:
Review concepts of Curve tracing (Cartesian - Polar and Parametric curves)-
Applications of Integration to Lengths, Volumes and Surface areas of revolution in Cartesian and Polar Coordinates.
Multiple integrals - double and triple integrals – change of variables – Change of order of Integration
Application: Moments of inertia
Subject Category
ABET Learning Objectives a e d
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT IV Special functions:
Beta and Gamma functions- Properties - Relation between Beta and Gamma functions- Evaluation of improper integrals
Application: Evaluation of integrals
Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT V Vector Differentiation:
Gradient- Divergence- Curl - Laplacian and second order operators -Vector identities
Application: Equation of continuity, potential surfaces
Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

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.
application: work done, Force
Subject Category
ABET Learning Objectives a e

ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

BOOKS:

1. **GREENBERG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
2. **B.V. RAMANA,** Higher Engineering Mathematics, Tata McGrawhill
3. **ERWIN KREYSZIG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
4. **PETER O'NEIL,** Advanced Engineering Mathematics, Cengage Learning
5. **D.W. JORDAN AND T. SMITH,** Mathematical Techniques, Oxford University Press

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	a) Apply knowledge of math, science, & engineering b) Design & conduct experiments, analyze & interpret data c) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints d) Function on multidisciplinary teams e) Identify, formulate, & solve engineering problems f) Understand professional & ethical responsibilities g) Communicate effectively h) Understand impact of engineering solutions in global, economic, environmental, & societal context i) Recognize need for & be able to engage in lifelong learning j) Know contemporary issues k) Use techniques, skills, modern tools for engineering practices	1. Objective tests 2. Essay questions tests 3. Peer tutoring based 4. Simulation based 5. Design oriented 6. Problem based 7. Experiential (project based) based 8. Lab work or field work based 9. Presentation based 10. Case Studies based 11. Role-play based 12. Portfolio based	A. Questions should have: B. Definitions, Principle of operation or philosophy of concept. C. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. D. Design oriented problems E. Trouble shooting type of questions F. Applications related questions G. Brain storming questions	

Year – II SEMESTER

T	P	C
3+1	0	3

ENGINEERING PHYSICS

UNIT-I
PHYSICAL OPTICS FOR INSTRUMENTS

"Objective Designing an instrument and enhancing the resolution for its operation would be effective as achieved through study of applicational aspects of physical Optics"

INTERFACE : Introduction – Interference in thin films by reflection – Newton's rings.

DIFFRACTION : Introduction – Fraunhofer diffraction - Fraunhofer diffraction at double slit (qualitative) – Diffraction grating – Grating spectrum – Resolving power of a grating – Rayleigh's criterion for resolving power.

POLARIZATION : Introduction – Types of Polarization – Double refraction – Quarter wave plate ad Half Wave plate.

UNIT-II
COHERENT OPTICS – COMMUNICATIONS AND STRUCTURE OF MATERIALS

Objectives while lasers are trusted Non-linear coherent sources established for the fitness of instrumentation, establishing a structure property relationship for materials requires allotment of an equivalent footing in convening the physics knowledge base.

LASERS: Introduction – coherent sources – Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Three and Four level pumping schemes – Ruby laser – Helium Neon laser.

FIBER OPTICS : Introduction – Principle of Optical Fiber – Acceptance angle and acceptance cone – Numerical aperture.

CRYSTALLOGRAPHY : Introduction – Space lattice – Basis – Unit Cell – Lattice parameters – Bravais lattices – Crystal systems – Structures and packing fractions of SC,BCC and FCC

X-RAY DIFFRACTION TECHNIQUES : Directions and planes in crystals – Miller indices – Separation between successive [h k l] planes – Bragg's law.

UNIT-III
MAGNETIC, ELECTRIC FIELD RESPONSE OF MATERIALS & SUPERCONDUCTIVITY

"Objective many of the Electrical or Electronic gadgets are designed basing on the response of naturally abundant and artificially made materials, while their response to E- or H- fields controls their performance.

MAGNETIC PROPERTIES : Magnetic permeability – Magnetization – Organ or magnetic moment – Classification of Magnetic materials – Dir, para, Ferro, anti ferro and ferri-magnetism – Hysteresis curve

DIELECTRIC PROPERTIES : Introduction – Dielectric constant – Electronic, ionic and orientational polarization – internal fields – Clausius – Mossotti equation – Dielectric loss, Breakdown and Strength.

SUPERCONDUCTIVITY : General properties – Meissner effect – Type I and Type II superconductors – BCS Theory Flux quantization London's equations – Penetration depth – DC and AC Josephson effects – SQUIDS.

UNIT – IV
ACOUSTICS AND EM – FIELDS:

Objective: The utility and nuances of ever pervading SHM and its consequences would be the first hand-on to as it clearly conveyed through the detailed studies of Acoustics of Buildings, while vectorial concepts of EM fields paves the student to gear – up for a deeper understanding.

ACOUSTICS: Sound absorption, absorption coefficient and its measurements, Reverberations time – Sabine's formula, Eyring's formula.

ELECTRO-MAGNETIC FIELDS: Gauss and stokes theorems (qualitative) – Fundamental laws of electromagnetism – Maxwell's Electromagnetic Equations (Calculus approach).

UNIT – V
QUANTUM MECHANICS FOR ELECTRONIC TRANSPORT

Objective: The discrepancy between classical estimates and laboratory observations of physical properties exhibited by materials would be lifted out through the understanding quantum picture of sub-atomic world dominated by electron and its presence.

QUANTUM MECHANICS: Introduction to matter waves – Schrodinger Time Independent and Time Dependent wave equations – Particle in a box.

FREE ELECTRON THEORY: Classical free electron theory – electrical conductivity – Mean free path – Relaxation time and drifty velocity – Quantum free electron theory – Fermi – Dirac (analytical) and its dependence on temperature – Fermi energy – density of states – derivations for current density.

BAND THEORY OF SOLIDS: Bloch theorem (qualitative) – Kronig – Penney model – Origin of energy band formation in solids – Classification of materials into conductors, semi – conductors & insulators – Concepts of effective mass of electron - concept of hole.

UNIT – VI

SEMICONDUCTOR PHYSICS:

Objective: In the wake of ever increasing demand for the space and power the watch word "small is beautiful", understanding the physics of electronic transport as underlying mechanism for appliances would provide a knowledge base.

Introduction – Intrinsic semiconductor and carrier concentration – Equation for conductivity – Extrinsic semiconductor and carrier concentration – Drift and diffusion – Einstein's equation – Hall Effect – direct & indirect band gap semiconductors – Electronic transport Mechanism for LEDs, Photo conductors and solar cells.

TEXT BOOKS

1. Solid state Physics by A.J. Dekker (Mc Millan India Ltd)
2. A text book of Engineering Physics by M.N. Avadhanulu & P.G. Kshirasagar (S. Chand publications)
3. Engineering Physics b;y M.R. Srinivasan (New Age international publishers)

REFERENCE BOOKS

1. 'Introduction to solid state physics' by Charles Kittle (Willey India Pvt.Ltd)
2. 'Applied Physics' by T. Bhimasenkaram (BSP BH Publications)
3. 'Applied Physics' by M.Arumugam (Anuradha Agencies)
4. 'Engineering Physics' by Palanisamy (Scitech Publishers)
5. 'Engineering Physics' by D.K.Bhattacharya (Oxford University press)
6. 'Engineering Physics' by Mani Naidu S (Pearson Publications)
7. 'Engineering Physics' by Sanjay D Jain and Girish G Sahasrabudhe (University Press)
8. 'Engineering Physics' by B.K.Pandey & S. Chaturvedi (Cengage Learning)

I Year – II SEMESTER

T	P	C
3+1	0	3

Professional Ethics and Human Values

UNIT I : Human Values:
Morals, Values and Ethics – Integrity – 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 : Engineering Ethics:
The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics-Consensus and Controversy –Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Types of Inquiry – Engineering and Ethics-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma.

UNIT III : Engineering as Social Experimentation:
Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering.

UNIT IV : Engineers' Responsibility for Safety and Risk:
Safety and Risk, Concept of Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

UNIT V : Engineers' Responsibilities and Rights:
Collegiality-Techniques for Achieving Collegiality –Two Senses of Loyalty-obligations of Loyalty-misguided Loyalty – professionalism and Loyalty- Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems – Self-interest, Customs and Religion- Ethical egoism-Collective bargaining-Confidentiality-Acceptance of Bribes/Gifts-when is a Gift and a Bribe-examples of Gifts v/s Bribes-problem solving-interests in other companies-Occupational Crimes-industrial espionage-price fixing-endangering lives- Whistle Blowing-types of whistle blowing-when should it be attempted-preventing whistle blowing.

UNIT VI : Global Issues:
Globalization- Cross-culture Issues-Environmental Ethics-Computer Ethics-computers as the instrument of Unethical behaviour-computers as the object of Unethical Acts-autonomous computers-computer codes of Ethics-Weapons Development-Ethics and Research-Analysing Ethical Problems in Research-Intellectual Property Rights.

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Text Books:

1. "Engineering Ethics and Human Values" by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009
2. "Professional Ethics and Morals" by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran-Laxmi Publications
4. "Professional Ethics and Human Values" by Prof.D.R.Kiran-
5. "Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication
6. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.

7. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

I Year – II SEMESTER

T	P	C
3+1	0	3

ENGINEERING DRAWING

Objective: Engineering drawing being the principle method of communication for engineers, the objective 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: The objective is to introduce the use and the application of drawing instruments and to make the students construct the polygons, curves and various types of scales. The student will be able to understand the need to enlarge or reduce the size of objects in representing them.

Polygons, Construction of regular polygons using given length of a side; Ellipse, arcs of circles and Oblong methods; Scales – Vernier and Diagonal scales.

UNIT II

Objective: The objective is to introduce orthographic projections and to project the points and lines parallel to one plane and inclined to other.

Introduction to orthographic projections; projections of points; projections of straight lines parallel to both the planes; projections of straight lines – parallel to one plane and inclined to the other plane.

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 inclinations and traces.

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 K.L.Narayana & P. Kannaiah, Scitech Publishers.
3. Engineering Graphics by PI Varghese, McGrawHill Publishers

REFERENCE BOOKS:

1. Engineering Graphics for Degree by K.C. John, PHI Publishers
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers
3. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

I Year – II SEMESTER

T	P	C
0	3	2

ENGLISH – COMMUNICATION SKILLS LAB – II

Suggested Lab Manuals:

OBJECTIVE: To impart to the learner the skills of grammar as well as communication through listening, speaking, reading, and writing including soft, that is life skills.

ADVANCED COMMUNICATION SKILLS

UNIT 6	Body language
UNIT 7	Dialogues
UNIT 8	Interviews and Telephonic Interviews
UNIT 9	Group Discussions
UNIT 10	Presentation Skills
UNIT 11	Debates

Text Book:

'Strengthen your Communication Skills' Part-B by Maruthi Publications

Reference Books:

1. INFOTECH English (Maruthi Publications)
2. Personality Development and Soft Skills (Oxford University Press, New Delhi)

I Year – II SEMESTER

T	P	C
0	3	2

ENGINEERING PHYSICS LAB

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 thin object using 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 stretched string – Sonometer.
8. Determination of velocity of sound – Volume resonator.
9. L C R Senes Resonance Circuit
10. Study of I/V Characteristics of Semiconductor diode
11. I/V characteristics of Zener diode
12. Thermistor characteristics – Temperature Coefficient
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 for semiconductor.

REFERENCE:

1. Engineering Physics Lab Manual by Dr.Y. Aparna & Dr.K.Venkateswarao (V.G.S.Book links)
2. Physics practical manual, Lorven Publications.

I Year – II SEMESTER

T	P	C
0	3	2

Engineering Physics
Virtual Labs - Assignments

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

URL : WWW.vlab.co.in

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: Enabling the student to understand basic hardware and software tools through practical exposure

PC Hardware:
Identification of basic peripherals, assembling a PC, installation of system software like MS Windows, device drivers. Troubleshooting Hardware and software _ some tips and tricks.

Internet & World Wide Web:
Different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet, web browsers, email, newsgroups and discussion forums .Awareness of cyber hygiene(protecting the personal computer from getting infected with the viruses), worms and other cyber attacks .

Productivity tools Crafting professional word documents; excel spread sheets, power point presentations and personal web sites using the Microsoft suite of office tools

(Note: Student should be thoroughly exposed to minimum of 12 Tasks)

PC Hardware

Task 1: Identification of the peripherals of a computer.
To prepare a report containing the block diagram of the CPU along with the configuration of each peripheral and its functions. Description of various I/O Devices

Task 2(Optional) : A practice on disassembling the components of a PC and assembling them to back to working condition.

Task 3: Examples of Operating systems- DOS, MS Windows, Installation of MS windows on a PC.

Task 4: Introduction to Memory and Storage Devices , I/O Port, Device Drivers, Assemblers, Compilers, Interpreters , Linkers, Loaders.

Task 5:

Hardware Troubleshooting (Demonstration):

Identification of a problem and fixing a defective PC(improper assembly or defective peripherals).

Software Troubleshooting (Demonstration):. Identification of a problem and fixing the PC for any software issues

Internet & Networking Infrastructure

Task 6: Demonstrating Importance of Networking, Transmission Media, Networking Devices- Gateway, Routers, Hub, Bridge, NIC ,Bluetooth Technology, Wireless Technology, Modem, DSL, Dialup Connection.

Orientation & Connectivity Boot Camp and web browsing: Students are trained to configure the network settings to connect to the Internet. They are trained to demonstrate the same through web browsing (including all tool bar options) and email access.

Task 7: **Search Engines & Netiquette:**

Students are enabled to use search engines for simple search, academic search and any other context based search (Bing, Google etc). Students are acquainted to the principles of micro-blogging, wiki, collaboration using social networks, participating in online technology forums

Task 8: Cyber Hygiene (Demonstration): Awareness of various threats on the internet. Importance of security patch updates and anti-virus solutions. Ethical Hacking, Firewalls, Multi-factor authentication techniques including Smartcard, Biometrics are also practiced

Word

Task 9 : MS Word Orientation:

Accessing, overview of toolbars, saving files, Using help and resources, rulers, formatting ,Drop Cap , Applying Text effects, Using Character Spacing, OLE in Word, using templates, Borders and Colors, Inserting Header and Footer, Using Date and Time option, security features in word, converting documents while saving

Task 10: Creating project : Abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check , Track Changes, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs.

Excel

Task 11: Using spread sheet features of EXCEL including the macros, formulae, pivot tables, graphical representations

Creating a Scheduler - Features to be covered:- Gridlines, Format Cells, Summation, auto fill, Formatting Text

LOOKUP/VLOOKUP

Task 12: Performance Analysis - Features to be covered:- Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

Power Point

Task 13: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes :- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting –Images, Clip Art, Tables and Charts in Powerpoint.

Task 14: Focusing on the power and potential of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topic covered during this week includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background, textures, Design Templates, Hidden slides, OLE in PPT.

TEXT BOOK:

Faculty to consolidate the workshop manuals using the following references

1. Computer Fundamentals, Anita Goel, Pearson
2. Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson,2008
3. Information Technology Workshop,3e, G Praveen Babu, M V Narayana BS Publications.
4. Comdex Information Technology , Vikas Gupta, dreamtech.

REFERENCE BOOK:

1. Essential Computer and IT Fundamentals for Engineering and Science Students, Dr. N.B. Venkateswarlu

II Year – I SEMESTER

T	P	C
3+1	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 principles-Reed Hill – CENGAGE Learning Publishers

REFERENCES:

1. Engineering Physical Metallurgy and Heat Treatment – Y. Laktin.
2. Elements of Physical Metallurgy – A.Guy
3. Metallographic laboratory practice – Kehl
4. Principles of Physical Metallurgy – Smith. M.
5. Introduction to Metallurgy – A.H. Cottrell
6. Metallurgy for Engineers-Clark and varney.
7. Physical Foundations of Materials Science – G. Gottstein
8. The Science and Engineering of Materials – Askeland et. al.
9. Physical Metallurgy – William F Hasford – CRC Press

II Year – I SEMESTER

T	P	C
3+1	0	3

MECHANICS OF SOLIDS

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.

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.

UNIT – IV

Objective: After studying this unit student will know how to finding slope and deflection for different support arrangements by Double integration method, Macaulay's method and Moment-Area and also problem solving techniques.

DEFLECTION OF BEAMS : Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams.

Brief explanation of Statically Indeterminate Beams and solution methods.

UNIT – V

Objective: After studying this unit student will know how a cylinder fails, what kind of stresses induced in cylinders subjected to internal, external pressures and also problem solving techniques.

THIN CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells.

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

UNIT –VI

Objective: After studying this unit student will know shear stresses induced in circular shafts, discussing columns in stability point of view and columns with different end conditions.

TORSION: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

COLUMNS:

Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula,

TEXT BOOKS:

1. Strength of materials by Bhavikatti, Lakshmi publications.
2. Solid Mechanics, by Popov
3. Mechanics of Materials by - Ferdinand P Beer, E Russell Johnston, and John T Dewolf.

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.

II Year – I SEMESTER

T	P	C
3+1	0	3

MECHANICS OF FLUIDS

***Objective:** 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 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 – II

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 – III

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,

UNIT – IV

Objective: After studying this unit student can be able to understand by approximate solution of N.S equations and Von-Karman's Prandtl equation. Describe the various velocity gradients, pressure gradients of a boundary layer separation concepts. Basic definations about drag lift and magnus effect.

Flow through notches and weirs, Viscometers, Hot wire Anemometers, Pitot tube, Flow through nozzles. Approximate solutions of N.S. Equations - Boundary layer- concepts, Prandtl contribution,Characteristices of boundary layer along a thin flat plate Von-karman's momentum integral equation (No derivation), laminar and turbulent Boundary layers,BL in transition,separation of BL,control of BL separation,flow around submerged objects, Drag and lift – types of drag – magnus effect.

UNIT – V

Objective: After studying this unit student shall understand the flow characteristics of real fluids and should be able to calculate the various losses and friction factor for flow through tubes.

Closed Conduit Flow: Characteristics of real fluids – Reynolds experiment –Darcy's equation, Minor losses – pipes in series – pipes in parallel – Total energy line and hydraulic gradient line. Exact Solutions of Navier

Stokes Equations. Flow between parallel plates, flow through long tubes, Flow through inclined tubes, Turbulent flow, variation of friction factor with Reynold's Number.

UNIT VI

Objective: After studying this unit student shall understand the characteristics of compressible fluids and should be able to calculate the values of Mach number and related parameters.

Flow of Compressible Fluid: Introduction, Thermodynamic relations, basic equations of compressible flow, velocity of sound wave in a fluid for isothermal and adiabatic process, mach number and its applications, mach angle, Propagation of Pressure waves and stagnation properties

TEXT BOOKS:

1. Fluid Mechanics Hydraulics and Hydraulics Machines Modi & Seth, Standard publications, New Delhi.
2. Engineering Fluid Mechanics by K.L.Kumar, S.Chand & Co.

REFERENCES :

1. Fluid Mechanics – Frank in white Mc-Grawhill.
2. Fluid Mechanics - John – F.Dauglas, Pearson Educations publishers.
3. Fluid Mechanics & Hydraulic Machines - D. Ramadurgaiah, Newage Publishers.

II Year – I SEMESTER

T	P	C
3+1	0	3

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Unit – I: (*The Learning objective of this Unit is to understand the concept and nature of Managerial Economic s and its relationship with other disciplines, Concept of Demand and Demand forecasting)
Introduction to Managerial Economics and demand Analysis:
Definition of Managerial Economics and Scope-Managerial Economics and its relation with other subjects-Concepts of Demand-Types-Determents-Law of Demand its Exception-Elasticity of Demand-Types and Measurement-Demand forecasting and its Methods.
(**The Learner is equipped with the knowledge of estimating the Demand for a product and the relationship between Price and Demand)

Unit – II: (*The Learning objective of this Unit is to understand the concept of Production function, Input Output relationship, different Cost Concepts and Concept of Cost-Volume-Profit Analysis)
Production and Cost Analyses:
Production function-Isoquants and Isocosts-Law of Variable proportions-Cobb-Douglas Production function-Economics of Sale-Cost Concepts-Opportunity Cost-Fixed vs Variable Costs-Explicit Costs vs Implicit Costs-Out of Pocket Costs vs Imputed Costs-Cost Volume Profit analysis-Determination of Break-Even Point (Simple Problem)
(**One should understand the Cost Concepts for decision making and to estimate the least cost combination of inputs).

Unit – III: (*The Learning Objective of this Unit is t understand the Nature of Competition, Characteristics of Pricing in the different market structure and significance of various pricing methods)
Introduction to Markets, Theories of the Firm & Pricing Policies:
Market Structures: Perfect Competition, Monopoly and Monopolistic and Oligopoly – Features – Price, Output Determination – Managerial Theories of firm: Maris and Williamson's models – Methods of Pricing: Limit Pricing, Market Skimming Pricing, Internet Pricing: Flat Rate Pricing, Usage sensitive, Transaction based pricing, Priority Pricing.
(** One has to understand the nature of different markets and Price Output determination under various market conditions)

Unit – IV: (*The Learning objective of this Unit is to know the different forms of Business organization and their Merits and Demerits both public & private Enterprises and the concepts of Business Cycles)
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 Business Cycle.
(**One should equipped with the knowledge of different Business Units)

Unit – V: (*The Learning objective of this Unit is to understand the different Accounting Systems preparation of Financial Statements and uses of different tools for performance evaluation)
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 cash flow statements (Simple Problems)
(**The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis)

Unit – VI: (*The Learning objective of this Unit is to understand the concept of Capital, Capitalization, Capital Budgeting and to know the techniques used to evaluate Capital Budgeting proposals by using different methods)

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization: Meaning of Capital Budgeting-Need for Capital Budgeting-Techniques of Capital Budgeting-Traditional and Modern Methods. (**The Learner is able to evaluate various investment project proposals with the help of capital budgeting techniques for decision making)

Note: *Learning Objective

** Learning Assessment

Text Books

1. Dr. N. Appa Rao, 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.Prabhakara rao, Prof. P. Venkatarao. 'Managerial Economics and Financial Analysis', Ravindra Publication.

References:

1. V. Maheswari: Managerial Economics, Sultan Chand.
2. Suma Damodaran: Managerial Economics, Oxford 2011.
3. Dr. B. Kuberudu and Dr. T. V. Ramana: Managerial Economics & Financial Analysis, Himalaya Publishing House 2011.
4. Vanitha Agarwal: 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.

II Year – I SEMESTER

T	P	C
3+1	0	3

THERMODYNAMICS AND KINETICS

Course Objective: To provide a comprehensive coverage of the laws of thermodynamics and kinetics of chemical processes 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. 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.

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 aand 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. Introduction to the thermodynamics of materials 5th Edition– D.R. Gaskell – CRC Press
2. Physical chemistry for Metallurgists – J. Mackowick

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

T	P	C
3+1	0	3

ELEMENTS OF MECHANICAL ENGINEERING

(Objectives: The course conveys the basic concepts of Mechanical Engineering and exposes the students to a wide range of hardware and the hands-on nature of engineering. The subject provides a base for the students to understand various concepts relevant to boilers, compressors, IC engines, gear transmission etc..)

UNIT – I

(Learning Objectives: To understand the concepts of air standard cycles used in prime movers. To identify, formulate and solve engineering problems associated with various cycles used in prime movers of CI engines.)

Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blowdown-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles Of CI Engines.

Unit-II

(Learning Objectives: To understand the concept of steam generation for prime movers, also to design and conduct experiments, analyze and interpret data of various types of steam boilers.)

Steam boilers: classification of boilers, essentialities of boilers, selection of boilers, study of boilers, Cochran boiler, Locomotive boiler, Lancashire boiler, Babcock and Wilcox boiler, boiler mountings and accessories.

Unit-III

(Learning Objectives: To know the contemporary issues with various types of compressors used in various metallurgical industries. To identify, formulate and solve engineering problems involved with compressor systems.)

COMPRESSORS – Classification –positive displacement and roto dynamic machinery – Power producing and power absorbing machines, fan, blower and compressor – positive displacement and dynamic types – reciprocating and rotary types.

Reciprocating : Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance, stage compression, undercooling, saving of work, minimum work condition for stage compression.

Unit-IV

(Learning Objectives: To apply knowledge of maths, science and engineering to derive various formulae associated with IC engines. To know the contemporary issues of various types of engines.)

Internal combustion engines: classification of IC engines, basic engine components and nomenclature, working principle of engines, Four strokes and two stroke petrol and diesel engines, comparison of CI and SI engines, comparison of four stroke and two stroke engines, simple problems such as indicated power, brake power, friction power, specific fuel consumption, brake thermal efficiency, indicated thermal efficiency and mechanical efficiency.

Unit-V

(Learning Objectives: To design a transmission system to meet the desired needs and the existing constraints. Also to identify, formulate and solve engineering problems concerned with various drive systems.)

Belts –Ropes and chains: belt and rope drives, velocity ratio, slip, length of belt , open belt and cross belt drives, ratio of friction tensions, centrifugal tension in a belt, power transmitted by belts and ropes, initial tensions in the belt, Maximum tension - simple problems – chains: Length, angular speed ratio, Classification of chains.

Unit-VI

(Learning Objectives: To apply knowledge of maths, science and engineering to derive various formulae associated with gear transmissions widely used in industries. Also to understand safety, manufacturability and sustainability constraints involved with the systems.)

Gear trains: classification of gears, gear trains velocity ratio, simple, compound –reverted and epicyclic gear trains. Higher gear pairs – Friction wheels and toothed gears – Types – Law of gearing – Simple problems.

(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. An introduction to Mechanical Engineering – second edition – Jonadhan Wickert., CENGAGE publishers
2. Elements of Mechanical Engineering – A. S. Ravindra – Cengage Publishers – 8th Edition

Reference books:

1. Thermal Engineering, Ballaney,P.L., Khanna Publishers, 2003
2. Theory of Machines, S.S. Rattan , Tata McGraw Hill
3. Basic Mechanical Engineering – A R Israni and P K Shah – B S Publications.

II Year – I SEMESTER

T	P	C
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 Machine
5. Metallurgical Microscopes
6. Specimen Leveller.

II Year – I SEMESTER

T	P	C
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

T	P	C
3+1	0	3

MINERAL DRESSING

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 objectives 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 discuss the principles and working of classifiers. Theoretical study of various heavy media separation methods will also be carried. 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

T	P	C
3+1	0	3

INSTRUMENTATION

Course objective: To understand the need and scope of various measurement systems.

UNIT – I

Objectives: To understand the need and scope of various measurement systems used in material processing industries. This also helps the students to understand sources for errors in measurements and their remedial measures.

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics – sources of error, Classification and elimination of error.

UNIT – II

Objectives: To understand measurement system concepts for temperature and displacements used in metallurgical furnaces. Also it helps the students to understand calibration procedures for instrumentation.

Measurement of Displacement and Temperature: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

Classification – Ranges – Various Principles of measurement of temperature – Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators..

UNIT – III: To understand the concepts and design of pressure measurement systems used in steel and non-ferrous materials production industries.

Objectives

MEASUREMENT OF PRESSURE : Units – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

UNIT – IV

Objectives: To understand measurement systems of level and flow measurements in melting furnaces. It also helps the students to understand measurement systems of gas flow velocities in process industries.

MEASUREMENT OF LEVEL : Direct method – Indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – Bubler level indicators.

FLOW MEASUREMENT : Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

UNIT – V:

Objectives: To understand principles, operation and design of speed, acceleration and vibration systems of various sub-systems used in metallurgical industries

MEASUREMENT OF SPEED, ACCELERATION AND VIBRATION : Mechanical Tachometers – Electrical tachometers – Stroboscope, Noncontact type of tachometer

Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using above principle.

UNIT – VI

Objectives: To understand concepts of stress and strain measurements for various sub-systems used in furnaces. Also to identify, formulate and solve engineering problems for calculation of torques needed in selection of suitable motors for operating various metallurgical systems.

STRESS STRAIN MEASUREMENTS: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes.

TEXT BOOKS :

1. Measurement Systems: Applications & design by D.S Kumar.
2. Mechanical Measurements - BeckWith, Marangoni,Linehard, PHI / PE

REFERENCES :

1. Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik and Dhanesh/ TMH
2. Instrumentation and Control systems/ S.Bhaskar/ Anuradha Agencies.
3. Experimental Methods for Engineers / Holman.
4. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
5. Instrumentation & mech. Measurements by A.K. Tayal ,Galgotia Publications
6. Instrumentation, measurement & analysis by B.C.Nakra & K.K.Choudhary, TMH
7. Mechanical Measurements /sahani

II Year – II SEMESTER

T	P	C
3+1	0	3

METALLURGICAL ANALYSIS

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 BOOK:

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.

II Year – II SEMESTER

T	P	C
3+1	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 – II SEMESTER

T	P	C
3+1	0	3

ELECTRICAL & 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:

i. To learn the basic principles of electrical law's and analysis of networks.
ii. To understand the principle of operation and construction details of DC machines.
iii. To understand the principle of operation and construction details of transformer.
iv. To understand the principle of operation and construction details of alternator and 3-Phase inductio motor.
v. To study the operation of PN junction diode, half wave, full wave rectifiers and OP-AMPs.
vi. 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 and star-delta and delta-star transformations.

UNIT - II

DC MACHINES : Principle of operation of DC generator – emf equation - types – DC motor types –torque equation – applications – three point starter, swinburn's Test, speed control methods.

UNIT - III

TRANSFORMERS: Principle of operation of single phase transformers – emf equation – losses –efficiency and regulation.

UNIT - IV

AC MACHINES: Principle of operation of alternators – regulation by synchronous impedance method –principle of operation of 3-Phase induction motor – slip-torque characteristics - efficiency – applications.

UNIT V

RECTIFIERS & LINEAR ICs: PN junction diodes, diode applications (Halfwave and bridge rectifiers). Characteristics of 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, single stage CE Amplifier, frequency response of CE amplifier, concepts of feedback amplifier.

Outcomes:

i. Able to analyse the various electrical networks.
ii. Able to understand the operation of DC generators, 3-point starter and conduct the Swinburne Test.
iii. Able to analyse the performance of transformer.
iv. Able to explain the operation of 3-phase alternator and 3-phase induction motors.
v. Able to analyse the operation of half wave, full wave rectifiers and OP-AMPs.
vi. Able to explain the single stage CE amplifier and concept of feedback amplifier.

TEXT BOOKS:

1. Electronic Devices and Circuits, R.L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.
2. Electrical Technology by Surinder Pal Bali, Pearson Publications.
3. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group

REFERENCE BOOKS:

1.Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah,TMH Publications
2.Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications,2nd edition
3. Basic Electrical Engineering by Nagsarkar,Sukhija, Oxford Publications,2nd edition
4. Industrial Electronics by G.K. Mittal, PHI

II Year – II SEMESTER

T	P	C
3+1	0	3

METALLURGICAL THERMODYNAMICS

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.

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, Temperature dependence of the diffusion coefficient, 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 study and evaluate thermal properties of solids
Thermal properties: Specific heats of solids, classical, Einstein and Debyees' Model of the lattice, Specific heat of solids, Anhamaonicity, thermal expansion, thermal conductivity of solids, lattice thermal conductivity and thermo-electric effects. Stability of crystal disorders.

UNIT-IV
Learning objective: To understand the basic thermodynamic concepts of solutions with their applications.
Solutions: Composition, partial molal quantities, ideal solutions, Raoults Law, actual (Nonideal) solutions, Sieverts law, Gibb's - Duhem equation, integration of Gibbs' - Duhem equation, Excess thermodynamics quantitie

UNIT-V
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-VI
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.

(Assessment: The student should be evaluated based on the assignments aand 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. Physical chemistry of Metals-LS Darken and Gurry
2. Physcial chemistry for metallurgist-J Mackowick

REFERENCE BOOKS:

1. Thermodynamics of Solids RA Swalin
2. Physical Metallurgy Principles-RH Reed Hill
3. Material science; A First course-Raghavan

II Year – II SEMESTER

T	P	C
0	3	2

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.

1. Estimation of Iron in Iron ore. - to determine the percentage of Iron in Iron Ore by KMnO4 method and K2Cr2O7 method.
2. Estimation of Silicon in Cast Iron.
3. Estimation of Carbon in Steel by Strohlein apparatus method.
4. Estimation of Copper in Brass by Electrolytic method.
5. Estimation of manganese in cast iron.
6. Estimation of Chromium in Steel.
7. Estimation of Sodium and Potassium in Chloride Salts by Flame Photometry.
8. Estimation of lime in Limestone.
9. Estimation of the concentration of KMnO4 in the solution using Digital Spectrophotometer.
10. Estimation of Sulphur and Phosphorus in cast irons.
11. Estimation of Chromium in Stainless steels.
12. Estimation of Mn, Cr and Si in Ferro-Alloys

EQUIPMENT:

1. Optical emission spectrometer
2. Flame Photometer
3. Digital Spectrophotometer
4. Electronic digital balances – 2 No's

II Year – II SEMESTER

T	P	C
0	3	2

MINERAL DRESSING 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

III Year – I SEMESTER

T	P	C
4	0	3

INDUSTRIAL MANAGEMENT

Course Objective: *To impart knowledge on scientific principles of management to improve productivity in manufacturing industry)*

UNIT – I

Learning Objectives*: To introduce fundamentals of industrial engineering and management*

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, Fayol's principles of management.

UNIT – II

Learning Objectives*: To teach basics of plant layout and its design.*

Plant layout: Factors governing plant location, types of production layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, Plant maintenance, preventive and breakdown maintenance.

UNIT – III

Learning Objectives*: To introduce basic tools of operations management.*

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

Learning Objectives*: To teach statistical quality control techniques*

Statistical Quality Control: Quality control, its importance, Single and double sampling plans, OC curves and their uses; Control charts – $\bar{X}$ and R charts, $\bar{X}$ and S charts and their applications, numerical examples.

UNIT – V

Learning Objectives*: To teach concepts of personnel management and value engineering*

Resource Management: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, types. Value analysis: value engineering, implementation procedure.

UNIT – VI

Learning Objectives*: To provide fundamental principles of project management*

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

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. Production Management by Buffa,

III Year – I SEMESTER

T	P	C
4	0	3

MATERIAL CHARACTERIZATION TECHNIQUES

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.Kher 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 – I SEMESTER

T	P	C
4	0	3

FUELS, REFRACTORIES AND FURNACES

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 O.P.Gupta,Khanna Publishers.

REFERENCE BOOKS:

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.

III Year – I SEMESTER

T	P	C
4	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

T	P	C
4	0	3

IRON PRODUCTION

Course objective: *The subject deals with preparation of various types of iron ores, working principle of Blast Furnace etc.*

UNIT-I

Learning Objectives: *Study of ores, 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: *Sintering by various methods and sinter testing.*

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.B.F profile and designs 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: *Design and operation of Blast Furnace study.*

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.

III Year – I SEMESTER

T	P	C
4	0	3

NON FERROUS EXTRACTIVE METALLURGY

Course objective: *The subject deals with working principle of 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

III Year – I SEMESTER

T	P	C
0	3	2

FUELS, FURNACES AND REFRACTORIES 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" open and closed cup apparatus.
4. To find the flash and points of fuel oil by ABEL's Flash point apparatus
5. To find the viscosity of lubricant oil by using
   a. Red-wood-I Viscometer
   b. Red-wood-II Viscometer
   c. Saybolt Viscometer
6. To find the calorific value of solid and liquid fuels by using "Bomb Calorimeter"
7. To find the calorific value of gaseous fuels by using "Junker's Gas Calorimeter"
8. To study various types of refractories and find their densities, Hardness and slag penetration.

Equipment:

1. Muffle Furnace (1000^0 c) – 2 No's
2. Pensky Martins Apparatus
3. Abels Flash Point Apparatus
4. Red – wood – I Viscometer
5. Red – wood – II Viscometer
5. Say bolt Viscometer
6. Bomb Calorimeter
7. Junkers Gas Calorimeter
8. Compression testing Machine
9. Digital Electronic Balance

(Assessment: The student's performance should be evaluated at the end of each class 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.)*

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 – II SEMESTER

T	P	C
4	0	3

COMPOSITES

Course Objective: *This subject deals with advantages, applications of various types of Composites, and their manufacturing methods.*

UNIT-I
Learning Objective: *Understanding 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. Material Sciences and Technology – Vol 13 – Composites by Cahn – VCH, West Germany
2. Composite Materials-K.K.Chawla

Reference:

1. Hand Book of Composite Materials-ed-Lubin

III Year – II SEMESTER

T	P	C
4	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 BOOK

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 – II SEMESTER

T	P	C
4	0	3

MECHANICAL METALLURGY

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 of fatigue, its failure and the factors affecting fatigue failure.*

Fatigue Test: 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.

UNIT -VI

Learning Objective: *To know about creep, its failure and the factors affecting creep failure.*

Creep and Stress Rupture: Introduction, The 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.

(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. 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 – II SEMESTER

T	P	C
4	0	3

WELDING TECHNOLOGY

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 BOOK

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

T	P	C
4	0	3

HEAT TREATMENT TECHNOLOGY

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 BOOK

1. Heat Treatment Principle and Techniques-Rajan & Sharma

REFERENCES

1. Physical Metallurgy Lakhtin-Mir Publishers
2. Physical Metallurgy - Clark and Varney
3. Physical Metallurgy Principles - Reed Hill
4. Physical metallurgy-Ragavan
5. Heat Treat ment of metals-Zakharv-Mir Publishers

III Year – II SEMESTER

T	P	C
0	3	2

WELDING TECHNOLOGY LABORATORY

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.

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

L	T	C
0	3	2

HEAT TREATMENT 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. 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.

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

MECHANICAL METALLURGY 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. To study the radiographs of weldments.
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. Radiography 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)*

IV Year – I SEMESTER

T	P	C
4	0	3

METAL FORMING AND PRESS TOOLS

(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.

IV Year – I SEMESTER

T	P	C
4	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

T	P	C
4	0	3

COMPUTER APPLICATIONS IN METALLURGY AND MATERIALS

(Course Objective: To become familiar with the applications of computer / software packages in physical metallurgy and mathematical modeling of metallurgical processes.)

UNIT -I

(Learning Objective: To understand basic concepts of modeling, simulation of manufacturing process and also to develop methodology for process control)

INTRODUCTION TO MODELLING AND PROCESS CONTROL

Mathematical modeling, physical simulation, advantages and limitations, process control and instrumentation, gauges, thermocouples and other sensors.

UNIT -II

(Learning Objective: To revise mathematical concepts needed for modeling, simulation and analysis for product development. Also to acquire theoretical knowledge for solving problems in fluid flow and heat transfer)

MATHEMATICAL CONCEPTS: Review of differential equations, numerical methods, introduction to FEM, FDM, equations regarding fluid flow and heat transfer.

UNIT -III

(Learning Objective: To acquire hands on experience of software packages for analysis of temperature and material flow behavior in manufacturing processes)

SOFTWARE PACKAGES: Introduction to standard software packages – NISA, ANSYS, LOTUS etc. and their application to solve real time problems like estimation of temperature, stress and strain distribution in manufacturing processes.

UNIT -IV

(Learning Objective: To acquire hands on experience of software packages for development of expert systems in Metallurgical processes)

EXPERT SYSTEMS: Introduction to expert systems, applications of expert systems in metallurgical process, use of artificial intelligence and neural network development with practical training in the software packages.

UNIT -V

(Learning Objective: To develop computer programmes and graphics to construct phase diagrams for alloy design and crystallographic studies)

Computer Applications In Physical Metallurgy:

Use of computers for the construction of phase diagrams, alloys design and crystallography.

UNIT -VI

(Learning Objective: To develop theoretical models to understand metal flow in various manufacturing processes.)

Computer Applications In Process Metallurgy

Modeling and solidification of metal flow in casting, welding and forging processes.

(Course outcomes: The student should be able to

1. *Develop computer programmes for developing mathematical models and analysis of system components design*
2. *Use software packages like ANSYS, NISA etc. to solve real time problems in process metallurgy*
3. *Develop programmes for expert systems in Metallurgical processes using artificial intelligence and neural network techniques)*

(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. Trivedi R., Sekhar J.A., Majumudar J., "Principles of Solidification and Material Processing", Volume I&II, Oxford and IBH, New Delhi, 1989.

REFERENCES

1. AMIE, "Modeling of casting and welding process", Volume I & II, the Metallurgical society of AMIE, 1981&1983.
2. ASM, "Metals Handbook-Casting", Volume XV, 8th edition, American society for Metals, 1988.
3. Piwonoka T.S., Vollen V., Katgerman l., "Modeling of Casting, Welding, and Advanced Solidification Process", 4th edition, TMS-AIME, USA, 1993
4. Stocks G.M., Turchi P.E.A., "Alloy Modeling and Design", the Metals Society, AMIE, USA, 1994.
5. Cerjak H., "Mathematical Modeling of Weld Phenomenon-2", The Institute of Materials, 1995.

IV Year – I SEMESTER

T	P	C
4	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

Powder Metallurgy: Anish Upadhya and GS Upadhya- University Press

REFERENCES

1. Powder metallurgy – A.K. Sinha
2. Introduction to powder metallurgy – J.S. Hirshhorn
3. Treatise on Powder metallurgy – C. Goetzel Vol 1& II
4. Powder Metallurgy principles – F.V. Lenel

IV Year – I SEMESTER

T	P	C
4	0	3

OPEN ELECTIVE

NON–CONVENTIONAL SOURCES OF ENERGY

(Course Objective: To get knowledge over various non-conventional sources of energy and the importance of such energy in various applications)

UNIT – I

(Learning Objective: To study and learn about the principle of solar radiation and its utilization)

Principles Of Solar Radiation : Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II

(Learning Objective: To study and learn about the collection, storage and applications of solar energy)

Solar Energy Collection, Storage and Applications : Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Different methods of storage -, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT-III

(Learning Objective: To study and learn about the sources, production and utilization of wind energy and bio-mass)

Wind Energy & Bio-Mass: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT-IV

(Learning Objective: To study and learn about the resources, storage and utilization of geothermal energy)

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

UNIT-V

(Learning Objective: To study and learn about the resources, storage and utilization of Ocean energy)

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-VI

(Learning Objective: To study and learn various aspects of direct energy conversion)

Direct Energy Conversion : Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, seebeck, 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.

(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. Renewable energy resources/ Tiwari and Ghosal/ Narosa.
2. Non-Conventional Energy Sources /G.D. Rai

REFERENCES

1. Renewable Energy Sources /Twidell & Weir
2. Solar Energy /Sukhame
3. Splar Power Engineering / B.S Magal Frank Kreith & J.F Kreith.
4. Principles of Solar Energy / Frank Krieth & John F Kreider.
5. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.
6. Non-Conventional Energy Systems / K Mittal /Wheeler
7. Renewable Energy Technologies /Ramesh & Kumar /Narosa

INDUSTRIAL TRIBOLOGY
(OPEN ELECTIVE)

(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 modulus, 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 BOOK

1. Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI
2. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co.

REFERENCE

1. Tribology – B.C. Majumdar

SUPER ALLOYS

(OPEN ELECTIVE)

(Course Objective: To get knowledge over the properties, microstructure, melting and casting practice of super alloys. Forming and fabrication techniques of super alloys will also be studied.)

UNIT –I

(Learning Objective: To gain knowledge on basic fundamentals and selection criteria of super alloys.)

INTRODUCTION: Introduction to super alloys, Guide to selection of super alloys, Wrought super alloys, Heat Resistant castings.

UNIT –II

(Learning Objective: To understand the physical metallurgy of super alloys)

Physical Metallurgy: Microstructure of wrought Heat-Resisting Alloys, Microstructure of Ni-base & Co-base heat-resistant casting alloys. Temperature and Time-dependent Transformation. Application to Heat Treatment of High Temperature Alloys.

UNIT –III

(Learning Objective: To study the relationship between properties and microstructure of super alloys. High temperature resistance of super alloys will also be studied.)

Microsturucture and Properties - Relationship: Relationship of properties to Microstructure in super alloys. Fracture properties of super alloys. High temperature corrosion and use of castings for protection.

UNIT –IV

(Learning Objective: To get acquainted with the variables affecting the microstructure of super alloys.)

Effect of Physical Metallurgy and process variables on the microstructure: wrought super alloys. Process and Metallurgical factors affecting on superalloys and other high temperature materials.

UNIT- V

(Learning Objective: To know the melting and casting practice of super alloys. Various heat treatment techniques required to improve the quality of the castings are to be studied.)

Melting Process: Melting of Super alloys: Principles and practices of vacuum Induction Melting and Vacuum Arc melting.

Casting methods - Improving turbine blade performance by solidification control-The development of single crystal turbine blades. Quality of super alloy castings: Heat Treating of Heat resistant alloys

UNIT –VI

(Learning Objective: To know the fabrication techniques for the production of super alloys. Recent developments in the fabrication methods of super alloys will also be studied)

Forming Methods: Forming and Fabrication of super alloys: Recent developments in P/M of super alloys- Production of components by Hot-Isostatic Pressing.

(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. Super alloys: Source book: Mathew J. Donachie. Jr. editor : 1984.
2. The super alloys: edited by Chester T. Sins and William C Haagel: 1972.

REFERENCE

1. Campbell IE High temperature MATERIALS, John wiley and sons Inc.;1956

IV Year – I SEMESTER

T	P	C
4	0	3

ELECTIVE-I

LIGHT METALS AND ALLOYS

(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. Materials in Industry - W. J. Patton

REFERENCES

1. Introduction to Physical Metallurgy – S.H. Avner
2. Engineering Physical Metallurgy – Lakhtin
3. ASM Metals Handbook Vol-1 & 2

METALLURGICAL PROBLEMS
(ELECTIVE-I)

(Course Objective: To provide a comprehensive coverage problems on stoichiometric calculations, burden calculations, problems based on thermodynamics and kinetics. Problems should also be thoroughly practiced from pyrometallurgy, hydro metallurgy and electro metallurgy)

UNIT-I

(Learning Objectives: To solve problems on Stoichiometric calculations. Burden calculations. Mass balance and Energy balance calculations)

Stoichiometric calculations. Burden calculations. Mass balance and Energy balance calculations. Problems based on Principles of Thermodynamics

UNIT-II

(Learning Objectives: To solve problems based on kinetics and heat transfer)

Problems based on Kinetics of Metallurgical Processes and Heat Transfer.

UNIT-III

(Learning Objectives: To learn solving the problems based on theoretical flame temperature)

Problems on theoretical flame temperature.

UNIT-IV

(Learning Objectives: Tot learn solving the problems based on pyrometallurgy)

Problems on pyrometallurgy.

UNIT-V

(Learning Objectives: To learn solving the problems based on electro metallurgical processes)

Problems based on Electro Metallurgical processes.

UNIT-VI

(Learning Objectives: To learn solving the problems based on hydro metallurgical processes)

Problems of Hydro Metallurgical 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 BOOK

1. Metallurgical problems-Butts

REFERENCES

1. Non-Ferrous Extractive Metallurgy-Bray.
2. Elements of Heat ransfer. -Jakob & Hawkins.
3. Metalurgical Problems – Dubey and Upadhaya

FRACTURE MECHANICS
(ELECTIVE I)

(Course Objective: To provide a comprehensive coverage on fundamental concepts of fracture mechanics. He should clearly understand the mechanisms of Griffith theory, LEFM, EPF and failure of forging, castings and weldments. The student should be able to identify the reasons for failure of various components during applications)

UNIT-I

(Learning Objectives: To understand the basic concepts of failure modes, ductile-brittle transition and about the fracture at elevated temperature)

Introduction: Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile behaviour. Fracture in brittle and ductile materials – characteristics of fracture surfaces; inter-granular and intra-granular failure, cleavage and micro-ductility, growth of fatigue cracks, The ductile/brittle fracture transition temperature for notched and unnotched components. Fracture at elevated temperature.

UNIT-II

(Learning Objectives: To know the concepts relevant to G, R and R-curves)

Griffiths analysis: Concept of energy release rate, G, and fracture energy, R. Modification for ductile materials, loading conditions. Concept of R curves.

UNIT-III

(Learning Objectives: To know the mechanism of LEFM. He should clearly understand various terms pertaining to LEFM)

Linear Elastic Fracture Mechanics (LEFM): Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, stress intensity factor and the material parameter the critical stress intensity factor, crack tip plasticity, effect of thickness on fracture toughness.

UNIT-IV

(Learning Objectives: To know the mechanism of EPFM. He should clearly understand various terms pertaining to EPFM)

Elastic-Plastic Fracture Mechanics; (EPFM). The definition of alternative failure prediction parameters, Crack Tip Opening Displacement, and the J integral. Measurement of parameters and examples of use.

UNIT-V

(Learning Objectives: To be able to analyze the causes for failures in various castings, forgings and weldments)

Failure Of Forging, Casting And Weldments

Causes of Failure in Forging like material characteristics, Deficiencies in design, Improper Processing / Fabrication or Deterioration resulting from service conditions, Failure of Iron and Steel Castings, effect of Surface Discontinuities, Internal Discontinuities, Microstructure, Improper Composition, Improper Heat Treatment, Stress Concentration and Service Conditions. Failure of Weldments - Reasons for Failure procedure for Weld Failure Analysis.

UNIT-VI

(Learning Objectives: To understand the reliability concept and other functions associated with the reliability concept)

Reliability

Reliability Concept and Hazard Function, Life Prediction, Condition Monitoring, Application of Poisson. Exponential and Weibull Distribution for Reliability, Bath Rub Curve, Parallel and Series System, Mean Time Between Failures and Life Testing.

(Course outcomes: The student should be able to

1. *understand the failure of the products manufactured through various processes and suggest remedial methods*
2. *understand linear elastic fracture mechanics and elastic plastic fracture mechanics theories and apply them for fatigue studies*
3. *estimate reliability of the system and sensitivity of process parameters on quality of the product.)*

(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. Dislocations and Mechanical Behaviour of Materials – M. N. Shetty, PHI
2. T.L. Anderson, Fracture Mechanics Fundamentals and Applications, 2nd Ed. CRC press, (1995)

REFERENCES

1. B. Lawn, Fracture of Brittle Solids, Cambridge Solid State Science Series 2nd ed1993.
2. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths (1973)
3. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.

4. H.L.Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold, (1984).
5. S. Suresh, Fatigue of Materials, Cambridge University Press, (1998)
6. L.B. Freund and S. Suresh, Thin Film Materials Cambridge University Press,(2003).
7. G. E. Dieter, Mechanical Metallurgy, McGraw Hill, (1988)
8. D.C. Stouffer and L.T. Dame, Inelastic Deformation of Metals, Wiley (1996)
9. F.R.N. Nabarro, H.L. deVilliers, The Physics of Creep, Taylor and Francis, (1995)

(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)*

IV Year – I SEMESTER

T	P	C
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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

T	P	C
4	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, Mossbauer and Spectroscopy, 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 naon 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, naoprobes 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. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.
2. Nano Essentials- T.Pradeep/TMH

IV Year – II SEMESTER

T	P	C
4	0	3

ELECTIVE-II

CAD/CAM

(Course Objectives:

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

1. *Understand the basic analytical fundamentals that are used to create and manipulate geometric models in computer programs.*
2. *To visualize how the components looks like before its manufacturing or fabrication*
3. *To learn 2D & 3D transformations of the basic entities like line, circle, ellipse etc*
4. *To understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc.*
5. *To understand the different types of curves like Bezier curve, B-Spline curve & Graphics Standards*
6. *To understand different Algorithms for optimization of drawing of basic entities)*

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.

UNIT – II

Computer Graphics: Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

UNIT – III

Geometric Modeling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

UNIT – IV

Drafting and Modeling Systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling.

UNIT – V

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.

UNIT – VI

Group Tech: Part family, coding and classification, production flow analysis, advantages and limitations, computer aided processes planning, retrieval type and generative type.

UNIT – VII

Computer Aided Quality Control: Terminology in quality control, the computer in QC, contact inspection methods, noncontact inspection methods-optical, noncontact inspection methods-nonoptical, computer aided testing, integration of C AQC with CAD/CAM.

UNIT – VIII

Computer Integrated Manufacturing Systems: Types of manufacturing systems, machine tools and related equipment, material handling systems, computer control systems, human labor in the manufacturing systems, CIMS benefits.

TEXT BOOKS

1. CAD / CAM A Zimmers & P.Groover/PE/PHI
2. Automation, Production systems & Computer integrated Manufacturing/ Groover/P.E

REFERENCES

1. CAD / CAM Theory and Practice / Ibrahim Zeid / TMH
2. Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson
3. Computer Numerical Control Concepts and programming / Warren S Seames / Thomson.

(Course outcomes :

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

1. *Describe the mathematical basis in the technique of representation of geometric entitiesincluding points, lines, and parametric curves, surfaces and solid, and the technique of transformation of geometric entities using transformation matrix*
2. *Describe key neutral specifications and standards for product data*
3. *Students will be able to design parts in modern parametric CAD systems for manufacturing on a Rapid Prototyping machine.)*

SEMI CONDUCTORS AND MAGNETIC MATERIALS

(ELECTIVE-II)

(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. R.E. Hummel: Electronic Properties of materials.
2. R.A. Macurie: Ferromagnetic Materials structure and properties.

REFERENCE

1. An Introduction to Materials science-H.L.Mancini.

CERAMIC SCIENCE AND TECHNOLOGY

(ELECTIVE-II)

(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).

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 – John Wikey
2. FINCER proceedings of workshop on fine ceramics synthesis, properties and applications – T.R. Rammohan et al.

REFERENCE

1. Hand Book of Fibre-reinforced composite materials - Ed. Lubin.

EXPERIMENTAL TECHNIQUES IN METALLOGRAPHY

(Course objective: The main scope and objective is to give an overall view on the fundamental aspects of experimental techniques in metallography)

UNIT – I

(Learning Objectives: To get acquainted with the sample preparation required for metallography)

Polishing methods; Etching methods; light sources in optical microscopy; Numerical aperture, Resolution, depth of focus. Objective and eyepiece in optical microscope; lense defects; Optical methods of enhancing contrast dark field illumination; Polarized light phase contrast; Filters.

UNIT-II

(Learning Objectives: To get knowledge over diffraction patterns during the interaction of electron beams with matter)

Wave nature of electrons; Electron wavelengths; Interaction of electron beams with matter; effect of crystal structure; Representation of diffraction patterns- Reciprocal lattice and Reflecting sphere.

UNIT-III

(Learning Objectives: To get acquainted with the working principle and usage of electron microscope)

Electron microscope: Electron gum; Electromagnetic lenses and their observations; Resolving power; Depth of field and depth of focus; Fresnels fringer; Bright and dark field; selected area diffraction; Advantage and disadvantages of electron microscope.

UNIT-IV

(Learning Objectives: To get knowledge over the principle and working of TEM)

Specimen preparation for the TEM; Replica methods; Preparation of thin foils from bulk specimens; direct formation of thin films.

Transmission electron microscopy: Brief description of CTEM; Consideration of resolution; Topographical studies; Image contrast from stacking faults; Twinning; double diffraction and kikuchi lines.

UNIT-V

(Learning Objectives: To get acquainted with the working principle and usage of SEM)

Scanning electron microscope; basic priciples; resolving power; specimen requirement for SEM; preparatory methods for SEM specimen.

UNIT-VI

(Learning Objectives: To get thorough knowledge over the applications of SEM)

Application of SEM: Different types of modes used in SEM and their applications.

(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. 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.

REFERENCES

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.

PLASTICITY AND PLASTIC DEFORMATION

(Course Objective: To integrate knowledge of maths, science and manufacturing Engineering already acquired to understand deformation mechanism and various deformation theories of plasticity which may ultimately lead to understanding of material behavior that may help to produce quality products).

UNIT – I

(Learning objective: To understand the concept of plastic deformation, the phenomenon of cold working and workability under varied service conditions)

The interaction of material properties and process variables in plastic deformation processes. Phenomena of hot, warm and cold working. Flow stress and workability. Effect of hydrostatic pressure.

UNIT–II:

(Learning objective: To understand the 3D stress analysis and plastic instability along with component behavior under real working conditions)

3D stress analysis, plastic deformation and terminology, yield criteria and stress - strain relationships, work-hardening, plastic instability

UNIT–III:

(Learning objective: To understand and acquire knowledge of the elastic theory of materials under real conditions)

Elasticity Theory: The State of stress and strain, Two dimensional stress analysis, Plane stress, Plane strain, Equations of compatibility, Stress function, Boundary conditions, stress and strain tensor, tensor transformation, anisotropy , elastic stress-strain relation and elastic behaviour of anisotropic materials.

UNIT–IV:

(Learning objective: To understand the importance of various yield criteria and other aspects about yielding during deformation in real conditions)

Yielding and Plastic Deformation: Hydrostatic and Deviatoric stress, Octahedral stress, yield criteria (Von Mises and Tresca), texture and distortion of yield surface

UNIT–V:

(Learning objective: To understand the plastic deformation problems using slip line field theory to develop deformation models)

Slip line field theory: convention for slip lines, solutions of plastic deformation problem, Geometry of slip line field, Properties of the slip lines.

UNIT–VI:

(Learning objective: To solve the plastic deformation problems using slab method, upper bound and lower bound methods under varied service conditions)

Formulations of plastic deformation problems, application of theory of plasticity for solving metal forming problems using Slab method, upper and lower Bound methods, Slip line field theory.

(Course outcomes: The student should be able to

1. *understand dislocations and mechanical behavior of materials under elastic and plastic deformation at different strain rates.*
2. *Estimate the strength of the material for cold, warm and hot working conditions.*
3. *Use the data gathered to carryout design of various systems under given service conditions properly)*

(Assessment: The student should be evaluated based on the assignments aand 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. Dislocations and Mechanical Behaviour of Materials – J. N. Shetty, PHI
2. Plasticity and plastic deformation – Avitzur

REFERENCE

1. Mechanical Metallurgy – George E Dieter

TOOL STEELS

(ELECTIVE-III)

(Course objective: The main scope and objective is to obtain knowledge over the classification, heat treatment, properties and applications of tool steels)

UNIT-I

(Learning objective: To have an overall idea about the classification of tool steels)

Tool Steels-Classification of tool steels and importance. Water hardening tool steel (W Type) Shock resisting Tool steels (Style) Low alloy too steels (L-Types) and Mold Steels (P-Type)

UNIT-II

(Learning objective: To obtain knowledge over various types of cold work tool steels)

Cold work tool (die) steels & Heat treatment Oil hardening (O-Type) Medium-alloyed air hardening (A-Type) High carbon high chromium (D-Type)

UNIT-III

(Learning objective: To obtain knowledge over various types of hot work tool steels)

Hot work Die steels (H-Type) & Heat treatment;

H_1-H_{19} – Chromium base

H_1-H_{39} – Tungsten base

H_{40}-H_{59}-Molybdenum base.

UNIT-IV

(Learning objective: To obtain knowledge over various types of Mo and W based tool steels)

W-base and Mo-base highspeed tool steels: importance and Heat treatment.

UNIT-V

(Learning objective: To obtain knowledge over various types of special cutting materials)

Special Cutting materials-Powder metallurgy cemented carbide – WC, Tic, Tac Tool steels Stellites and Ceramic tools etc.,

UNIT-VI

(Learning objective: To obtain knowledge over various applications of tool steels)

Industrial applications of Tool Steels

(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 Physical Metallurgy by SH.Avener, Tata Mc Graw Hill
2. Toolsteels-Wilson-Pergamon Press

REFERENCE

1. ASM hand book on ferrous metals

IV Year – II SEMESTER

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ELECTIVE-IV

NUCLEAR METALLURGY

(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

Wright JC -Metallurgy in Nuclear Power Technology: Iliffe Book Ltd., 1962

REFERENCES

1. Wilkinson WD and Mrphy WF Nuclear Reactor Metallurgy Van Nostrand 1958
2. Symposium on Rare matierals: Indian Institute of Metals.
3. Glasstone S and Snesonske A; Prncipales of Nuclear Reactor Engineering: Macmillan, London.
4. Grainger L Uranium and Thorium: George Newnes Ltd., London.
5. Gurinsky DH and Dienes JL Nulcears Fuels, Macmillan.
6. US Atomic Energy Commission, Reactor Hand book Material Mc. Graw Hill Book Co. 1955
7. Proceedings of the symposium on Nuclear Science and Engineering – Bhabha Atomic Research Centre, Bombay.

FERRO ALLOY TECHNOLOGY

(ELECTIVE-IV)

(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. Riss M. And Khodorovsky V-Production ferroalloys Mir Publishers,Moscow 1967.
2. Symposium on ferro alloys NML Technical J.Feb 1962. World ferrochrome producers:Met bull.

REFERENCES

1. Manufacture of Iron and Steel. –Vol-1 G. R. Bashforth.
2. Making ,Shaping and treating of Steel by united Steel Corporations, Pittsburgh.

POLYMERIC MATERIALS

(ELECTIVE-IV)

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 polymerization, 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. Polymer science – Gowrikar

REFERENCES

1. Polymer Science & technology-Joel fried
2. Material Science –V.D.Kodgire.
3. Introduction to materials science & engineering-courtny & Hall

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NON-DESTRUCTIVE TESTING LABORATORY

OBJECTIVE

To provide hands on exposure to students on various non-destruction evaluation techniques.

LIST OF EXPERIMENTS

1 Visual inspection-unaided
2 Visual inspection-aided
3 Liquid penetrant inspection
4 Magnetic particles inspection
5 Eddy current testing
6 X-Ray Radiography
7 Identification and study of welding defects in radiographs
8 Identification and Study of casting defects in radiographs
9 Study of various types of penetrameters
10 X-ray film processing
11 Study of ultrasonic flaw detector
12 Study of IIW blocks and Reference Blocks
13 Calibration of time base using normal probe
14 Ultrasonic testing for defects in welds/castings, etc.
15 Ultrasonic thickness measurement

LIST OF EQUIPMENTS

1.	Magnetic Particle Inspection System.	1 No
2.	Eddy Current Tester	1 No
3.	X-Ray Machine	1 No
4.	X-Ray Film Viewer	4 No
5.	Ultrasonic Flaw Detector With Probes	2 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)*

IV Year – II SEMESTER

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PROJECT