B. Tech. METALLURGICAL ENGINEERING

SCHEME AND SYLLABI (with effect from 2022-23)B.Tech. (Chemical Engineering)

I Year - I Semester

Course code	Category	Course Title	Hours per week L	T	Internal Marks	External Marks	Total Marks	Credits
MT1101	BS	Maths– I	4	0	30	70	100	3
MT1102	BS	Physics	4	0	30	70	100	3
MT1103	ES	Engg.Graphics	2	3	30	70	100	3
MT1104	ES	Principles of Extractive Metallurgy	4	0	30	70	100	3
MT1105	ES	Fuels,Refractories&Furnaces	4	0	30	70	100	3
MT1106	ES	Workshop	0	3	50	50	100	1.5
MT1107	BS	PhysicsLab	0	3	50	50	100	1.5
MT1108	ES	FuelsLab	0	3	50	50	100	1.5
		Total Credits						19.5

B.TechIYear-IISemester

MT1201	BS	Maths–II	4	0	30	70	100	3
MT1202	BS	Green Chemistry	4	0	30	70	100	3
MT1203	HSS	English	4	0	30	70	100	3
MT1204	ES	CPNM	4	0	30	70	100	3
MT1205	ES	Industry 4.0	4	0	30	70	100	3
MT1206	HSS	EnglishLanguageLab	0	3	50	50	100	1.5
MT1207	BS	ChemistryLab	0	3	50	50	100	1.5
MT1208	ES	CPNMLab	0	3	50	50	100	1.5
		Total Credits						19.5

B.Tech -IIYear-ISemester

MT2101	BS	Metallurgical ThermodynamicsI	4	0	30	70	100	3
MT2102	PC	Mineral Beneficiation	4	0	30	70	100	3
MT2103	PC	Iron Making	4	0	30	70	100	3
MT2104	PC	PhysicalMetallurgy	4	0	30	70	100	3
MT2105	HSS	Managerial Economics	4	0	30	70	100	3
MT2106	PC	Materials Science	4	0	30	70	100	3
MT2107	PC	Mineral BeneficiationLab	0	3	50	50	100	1.5
MT2108	SC	Moulding and Castingpractice	1	2	50	50	100	2
MT2109	MC	Professional Ethics & Universal humanvalues	0	0	0	100	100	0
MT2110	MC	NCC/NSS	0	2	-	-	-	0
		Total Credits						21.5

B.Tech -IIYear-IISemester

MT2201	ES	HeatTreatment	4	0	30	70	100	3
MT2202	PC	Metallurgical Thermodynamics II	4	0	30	70	100	3
MT2203	PC	Python programmingtheory	4	0	30	70	100	3
MT2204	PC	Non-Ferrous Extractive Metallurgy-I	4	0	30	70	100	3
MT2205	PC	Mechanical properties of Materials	4	0	30	70	100	3
MT2206	PC	MetallographyLab	0	3	50	50	100	1.5
MT2207	PC	Python programming Lab	0	3	50	50	100	1.5
MT2208	SC	Welding Practice	1	2	50	50	100	2
MT2209	MC	Environmental Science	0	0	0	100	100	0
		Total Credits						20

Internship -I

MT1101: MATHEMATICS - I

Course Objectives:

* To transmit the knowledge of Partial differentiation.

* To know of getting maxima and minima of function of two variables and finding errors and approximations.

* To evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical functionas Fourier series and half-range Fourier series.

Course Outcomes:

* Findthepartialderivativesoffunctionsoftwoormorevariables.

* Evaluatemaximaandminima,errors and approximations.

* Evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

* Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

SYLLABUS

Partial Differentiation: Introduction - Functions of two or more variables - Partial derivatives -Homogeneous functions – Euler's theorem - Total derivative- Change of variables –Jacobins.Meanvalue Theorems (without proofs)

Applications of Partial Differentiation:Geometrical interpretation -Tangent plane and Normal to asurface-Taylor'stheoremforfunctionsoftwovariables-Errorsandapproximations-Totaldifferential.Maxima and Minima of functions of two variables - Lagrange's method of undeterminedmultipliers-Differentiation under theintegralSign-Leibnitz's rule.

Multiple Integrals: Introduction - Double Integrals - Change of Order of Integration - DoubleIntegralsin PolarCoordinates -TripleIntegrals- Changeof Variables.

Multiple Integrals-Applications: Area enclosed by plane curves - Volumes of solids - Area of acurved surface - Calculation of Mass - Center of gravity - Moment of inertia - product of inertia –principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions.Error Function orProbability Integral.

Fourier Series: Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functionshavingpointsofdiscontinuity-ChangeofInterval-OddandEvenFunctions-ExpansionsofOddorEvenPeriodic Functions,Half-RangeSeries -Parseval'sFormula.PracticalHarmonicanalysis.

TextBook:

1. Scope and Treatment as in" Higher Engineering Mathematics", by Dr.B.S.Grewal, 43rdEdition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by VBKumar Vatti., I.K.International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A textbook of Engineering Mathematics, by N.P.Bali and Dr.Manish Goyal, Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass.S.Chand Company.

5. Higher Engineering Mathematics by B.V.Ramana,Tata McGraw Hill Company.

6. Higher Engineering Mathematics by Dr.M.K.Venkataraman.

MT1102 : PHYSICS

CourseObjectives:

* To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.

* To grasp the concepts of physics for electromagnetis mandits application to engineering. Learn production of Ultrasonics and their applications in engineering.

* To Develop understanding of interference, diffraction and polarization: connectit to a few engineering applications.

* To Learn basics of lasers and optical fibers and their use in some applications.

* To Understand concepts and principles in quantum mechanics and Nanopahse Materials. Relate them to some applications.

Course Outcomes:

* Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understandtheworking ofCarnot cycle and concept ofentropy.

* GainKnowledge onthe basicconceptsof electric andmagnetic fields.Understandtheconcept of the nature of magnetic materials. Gain knowledge on electromagnetic inductionandits applications .

* Understand the Theory of Superposition of waves.Understand the formation of Newton'srings and the working of Michelson's interferometer. Remember the basics of diffraction,Evaluatethe pathdifference. AnalysisofFraunhofer Diffractionduetoa singleslit

* Understand the interaction of matter with radiation, Characteristics of Lasers, Principle,working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fibercommunication.

* Understand the intuitive ideas of the Quantum physicsand understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one Dimensional Schrodinger's waveequation. Understand the fundamentals and synthesis processes of Nanophasematerials.

SYLLABUS

Thermodynamics : Introduction, HeatandWork, First law of thermodynamics and applications, Reversible and Irreversible process,Carnot cycle and Efficiency, Secondlaw of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder,Third law of thermodynamics (statement only).

Electromagnetism: Concept of electric flux, Gauss's law - some applications, Magnetic field -Magnetic force oncurrent, torqueoncurrentloop, The Biot-Savart's Law, B near along wire, B

for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (noderivation), Magnetic materials: Classification of magnetic materials and properties.

Ultrasonic: Introduction, Production of Ultrasonic–Piezoelectricand Magnetostriction methods, acoustic grating, applications of Ultrasonic.

Optics-Interference : Principles of superposition–Young's Experiment–Coherence-Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications.

Diffraction : Introduction, Differences between in terference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhoferdiffractionatasingleslit (Qualitative and quantitative treatment).

Polarization: Polarization by reflection, refraction and double refraction in uniaxial crystals,Nicolprism, Quarter and Half waveplate, circular and elliptical polarization.

Lasers: Introduction, characteristics of a laser beam, spontaneous and stimulated emission ofradiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications oflasers

Fiber Optics: Introduction to optical fibers, principle of propagation of light in optical fibers,Acceptance Angle and cone of a fiber, Numerical aperture, Modes of propagations, classificationoffibers, fiberoptics incommunications, Application ofoptical fibers.

Modern Physics: Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Freeelectron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials in to conductors, semi conductors and insulators.

Nanophase Materials: Introduction, properties,Top-down and bottom up approaches, Synthesis - Ball milling, Chemical vapour deposition method, sol-gel methods, Applications of nanomaterials.

TextBooks :

1. Physics by David Halliday and Robert Resnick– PartI and PartII - Wiley.
2. A textbook of Engineering Physics, Dr. M.N.Avadhanulu, Dr. P.G. Kshirsagar-S. Chand
3. Engineering Physics by R.K.Gaurand S.L.Gupta – Dhanpat Rai

Reference Books:

1. Modern Engineering Physics by A.S. Vadudeva
2. University Physics by Young and Freedman

MT1103 : ENGINEERING GRAPHICS

Course Objectives:

* Understand the basics of Engineering Graphics and BISconventions.
* Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings
* Demonstrate and practice the various profiles / curves used in engineering practice through standard procedures.
* Demonstrate and practice the orthographic projections of points, lines, planes, solids and section of solids
* Demonstrate and practice the development of surfaces of simple solids
* Familiarize the basic concept of isometric views clearly.

Course Outcomes:

* DevelopsimpleengineeringdrawingsbyconsideringBISstandards.
* AbletodrawdifferentengineeringcurveswithstandardProcedures
* Comprehend the basics of orthographic projections and deduce orthographic projections of points, lines, planes and solids at different orientations inreal life environment.
* Visualizeclearlythesectionsof solids.
* Apply the concepts of development of surfaces while designing/analyzing any product.
* Recognize the significance of isometric drawing to relate 2 D environment with 3D environment.

SYLLABUS

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions, and Scales.

Curves: Conic sections,General construction of ellipse, parabola and hyperbola. Construction of involutes of circle and polygons only. Normal and tangent to curves.

Projections of Points: Principal or Reference Planes, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to oner eference plane and parallel to the other reference plane.

Projections of Straight Line Inclined to Both the Reference Planes: Projections of Planes: Projection of Perpendicular planes: Perpendicular to both reference planes, perpendicular to onereference plane and parallel to other reference plane and perpendicular to one reference planeand inclined to other reference plane. Projection of Oblique planes. Introduction to Auxiliary Planes.

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solidsin simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to otherand axesinclined to boththe reference planes.

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape ofsection,Sections ofsolids (Prism,Pyramid, Cylinderand Cone) in simpleposition only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Isometric Views: Isometric projection, Isometric scale and Isometric view. Isometric view of Prisms, Pyramids, cylinder, cone,and their combinations.

TextBook:

1. Elementary Engineering Drawing by N.D.Bhatt, Charotar Publishing House.

Reference Book:

2. Engineering Graphicsby K.L.Narayana and P. Kannaiah, TataMc-Graw Hill

MT1104: PRINCIPLES OF EXTRACTIVE METALLURGY

Course Objectives:

* Tolearn and emphasize the Principles of Pyrometallurgy, hydrometallurgy and electrometallurgy.
* To learn scientific concepts of extraction and refining
* Obtain knowledge of equipment used in Pyrometallurgy, hydrometallurgy and electrometallurgy

Course Outcomes:

* Classify and describe the extraction routes of pyrometallurgy, hydrometallurgy and electrometallurgy.

* To Illustrate with the help of flow sheet of process taking place in pyro-metallurgy, hydrometallurgy and electrometallurgical extractions of metal/matte.

* Choose the type of refining process according purity required.

* Understand the impact of extractive process on health environment society and will be able to suggest suitable technique store cycle the by products ortodecrease energy consumptions.

* Design the suitable process for extractions.

SYLLABUS

General Methods of Extraction. Pyro-metallurgy: Roasting,Types of roasting, Roasting equipment and methods, Predominance area diagrams, Smelting, Smelting furnaces.

Hydro Metallurgy: Advantages and disadvantages, Principles of leaching, Leaching kinetics and factors affecting.

ElectroMetallurgy-classification. Principles of refining. Use of vacuum, Zonerefining, Vacuum arc re-melting, Electron beam melting, Electro slag refining. Cementation. Electrorefining, Electro deposition.

Raw materials: Occurrence and distribution of iron ores in India. Evaluation of iron ore, coke and limest one. Preparation of ironores: Methods of Beneficiation, Agglomeration of Ironores.

Sintering and Pelletisation: Raw materials, Mechanism of sintering, Sintering machine and itsefficiency. Types of sinter.Recent trends in sintering practice. Pelletizing: Raw materials,Theory of Bonding, Bonding mechanism. Disc and Drum pelletiser, Firing units. Indian sintering and pelletisation plants.

Textbooks:

1. Introductiontomoderniron making,R.H.Tupkary
2. Introductiontomoderniron making,A.K.Biswas
3. PhysicalChemistryofIron&SteelMaking,C.Bodsworth
4. Extraction of Non-Ferrous Metals, H.S.Ray, R.Sridhar and K.P. Abraham

Reference Books:

1. MSTS-United Steel Corporation,Pitts burgh
2. Blastfurnace theory & practice- Vol.I& II,JuliusJH.Strysbugen
3. Metallurgy of Non-Ferrous Metals, Dennis,W.H.
4. Non-Ferrous Metallurgy, Sebryukov,N.Min, Pub.Moscow

MT1105 : FUELS, REFRACTORIES AND FURNACES

Course Objectives:

* This course is mainly intendedtodemonstratethe significance and characterization of conventional fuels that are employed in metallurgical processes.

* Gainan understanding of manufacture, testing, and applications of refractories.

* To gain knowledge related to working principles off urnacesused in metallurgical industries.

* To explain construction, salientfeaturesandheattransferaspectsofvarious furnaces.

Course Outcomes:

* Know about a fuel, classify them and compare different types of fuels and describe their testing methods. Explain the coke making process, list out the properties and its by- productsrecovery

* Apply principles of heat and mass transfer to basic engineering systems and understand thebasic concepts and lawsof the three modes of heat transfer and apply analytical techniques to the solution of conduction heat-transfer problems

* Classify and explain construction and working of different furnaces. Analyze causes of Heatlossesinfurnaces andsuggest methodsof minimizationit andWaste heatrecovery.

* Explain various manufacturing and testing processes of refractories. Link in herent properties of there fractory mineral and howit affects the production technology and the application.

SYLLABUS

Solidfuels: Classification Proximate analysis & ultimate analysis of coal. Carbonization of coal. Coke making and by products recovery. Testing and properties ofcoke.

Liquid fuels : Classification. Petroleum refining. Distillation.

Gaseousfuels: Classification. Production of PG,WG,CWG, LDgas, Coke oven gas and BFgas.

Refractories: Properties, classification and general description. Manufacture, properties and applications of Alumino-silicate, Silica, Dolomite, Magnesite, Chromite and Carbon refractories. Importance and study of SiC, ZrO2 and cermets. Testing of refractories.

Elements of heat transmission: Steady state conduction, convection and radiation.

Furnaces. Classification of furnaces and their use in metallurgical industries. Heat sources, Heat utilization in furnaces, Heat losses in furnaces and furnace efficiency. Heat balance and Sankey diagrams. Principles of waste heatrecovery. Recuperators and regenerators. Protective atmospheres.

Textbooks:

1. Fuels, furnaces and refractories by O.P. Gupta

2. Experimental methods for Engineers, J.P.Holman, McGraw Hill Publication.

Reference Books:

1. Fuels,Technology by Hinues
2. Fuels by Gilchrist
3. Refractories by Chesty

MT1106 : WORKSHOP

Course Objectives:

* The engineering workshop practice is included to introduce some common shop practices and on hands on experience to appreciate the use of skill, tools, equipment and general practices to all the engineering students.

* This laboratory course is aimed to provide the practical exposure to the students in the fields of Carpentry, Fitting, Sheet Metal and house electrical wiring works to

* Get hands on experience with the working skills in Carpentry trade.

* Knowhow to workwith Sheet Metaltools.

* Get familiar with thew or kings kills of Metal Fitting operations.

* Get hands on experience with household electrical wiring.

Course Outcomes:

* Canbeableto workwithWoodMaterials inrealtimeapplications.

* Canbeabletobuildvarious partswithSheetMetalinday-to-day life.

* Canbeableto applyMetalFittingskills invariousapplications.

* Can be able to apply this knowledge to basic house electrical wiring and repairs.

SYLLABUS

Carpentry: Any three jobs from – Half lap joint, Mortise and Tenon joint, Half – lap Dovetailjoint, Corner Dovetail joint, Central Bridlejoint.

Sheet Metal: Any three jobs from –Squaretray, Tapertray (sides), Funnel, Elbow pipe joint.

Fitting: Any three jobs from –Square, Hexagon, Rectangular fit, Circular fit and Triangular fit.

House wiring: Any three jobs from–Tubelight wiring, Ceiling fanwiring, Stair-case wiring, Corridor wiring.

Text Books:

1. Elements of workshop technology, Vol.1by S.K. and H.K. Choudary.
2. Workshop Manual/ P.Kannaiah/K.L.Narayana /SciTech Publishers.
3. Engineering Practices Lab Manual, Jeyapoovan, Saravana Pandian ,4/eVikas.

MT1107 : PHYSICSLAB

Course Objectives:

* Toenablethestudentstoacquireskill,technique andutilizationofthe Instruments

* Draw there levance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.

* To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.

* To familiarizethehandlingofbasic physical apparatus like Vernier callipers, screw gauge,

* spectrometers, travelling microscope, laser device, optical fibre, etc.

Course Outcomes:

* Ability to design and conduct experiments as well as to analyze and interpret

* A bility to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics

* The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

List of Experiments:

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton's Rings.
2. Determination of Wave length of Spectral Lines in the Mercury Spectrum by Normal Incidence method.
3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.
4. Determination of Cauchy's Constants of a Given Material of the Prismusing Spectrometer.
5. Determination of Refractive Index of Ordinary raymoand Extraordinary me ray.
6. Determination of Thickness Given Paper Strip by Wedge Method.
7. Calibration of Low Range Voltmeter.
8. Calibration of Low Range Ammeter.
9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.

10. Lees Method-Coefficient of thermal Conductivity of a Bad Conductor.

11. Carey Foster's Bridge–Verification of laws of Resistance and Determination Of Specific Resistance.

12. Melde's Apparatus–Frequency of electrically maintained Tuning Fork.

13. Photoelectric cell-Characteristics.

14. Planks Constants.

15. Laser- Diffraction.

MT1108 : FUELS LAB

Course Objectives:

At theend ofthe coursethe studentis expected to

* Toknowtheproceduresofdeterminingvariouspropertiesoffuels

* To get familiarized with the handling of equipment caloriemeters and viscometers

Course Outcomes:

* Ability to conduct experiments related to fuel properties

* Ability to gain experimental skills to determine the calorific value and viscosity of given fuel sample

List of experiments :

1. Determinationof Flashandfirepointsofoils.(Opencup)
2. Determinationof Flashandfirepointsofoils(Closedcup)
3. Determination of Calorific value of fuels (solids, liquids) by Bomb calorimeter
4. Determination of Calorific value offuels (gaseous) bygas calorimeter.
5. To determine the kinematic and absolute viscosity of the given sample oil using Redwood ViscometerI.
6. To determine the kinematic and absolute viscosity of the given sample oil using Redwood Viscometer II.
7. Determination of carbon residue.

SYLLABUS -I/ IV SECOND SEMESTER

MT 1201 MATHEMATICS-II

Course Objectives:

* The way of obtaining rank, eigen values and eigen vectors of a matrix.

* To know the importance of Cayley-Hamilton theorem and getting canonical form from a given quadratic form.

* To solve the system of equations by using direct and indirect methods.

* To solve first order and higher order differential equations by various methods.

* To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

Course Outcomes:

* Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.

* Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.

* Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling.

* Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.

* Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

SYLLABUS

Linear Algebra: Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination method, LU Factorization method, Gauss Seidal Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

Eigen Values and Eigen Vectors: Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form –Nature of a Quadratic Form.

Ordinary Differential Equations of First Order and its Applications: Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree – Linear differential equation- Bernoulli's equation – Exact differential equations – Equations reducible to exact equations – Orthogonal Trajectories – Simple Electric (LR&CR) Circuits – Newton's Law of Cooling – Law of Natural growth and decay.

Differential Equations of Higher Order: Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation -Simultaneous linear differential equations.

Laplace Transforms: Introduction – Existence Conditions – Transforms of Elementary Functions – Properties of Laplace Transforms- Transforms of

Derivatives- Transforms of Integrals - Multiplication by t^n - Division by t – Evaluation of integrals by Laplace Transforms –Inverse Laplace Transform – Applications of Laplace Transforms to Ordinary Differential Equations – Simultaneous Linear Differential equations with Constant Coefficients – Second Shifting Theorem – Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

Text Book:

1. Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.
2. Advanced Engineering Mathematics by Erwin Kreyszig.
3. A text book of Engineering Mathematics by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.
4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.
5. Higher Engineering Mathematics by B.V. Ramana, Tata McGraw Hill Company.

MT 1202 GREEN CHEMISTRY

Unit 1: Water Technology : Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Unit 2: Batteries : Primary batteries: The chemistry - Types: Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells – liquid cathode, solid cathode and lithium-ferrous sulphide cells. Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells. Advanced Batteries for electric vehicles, requirements of the battery – sodium-beta and redox batteries.

Unit 3: Fuel Cells : Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells- Membranes and Fuels

Unit 4: Corrosion : Corrosion: Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting, Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion. Corrosion Controlling Methods, Protective Coatings, Metallic Coatings, Electroplating and Electroless Plating – Chemical conversion coatings – Phosphate, Chromate, Anodized, Organic Coatings – Paints and Special Paints.

Unit 5: Green Chemistry and Technology : Introduction and significance of green chemistry, Goals of green chemistry, 12 principles of green chemistry, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, functional group approaches to green chemistry, Elimination of toxic functional group, optimization of frameworks for the design of greener synthetic pathways, Applications of green chemistry - Green solvents, green fuels and propellants, biocatalysis.

Text Books

1. Engineering Chemistry – PC Jain and M. Jain – DhanpathRai and Sons, New Delhi.
2. A Text book of Engineering Chemistry – S. S. Dara – S. Chand & Co. New Delhi.
3. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.

MT1203 ENGLISH

Course Objectives:

* To make students understand the explicit and implicit meanings of a text/topic;

* To give exposure to new words and phrases, and aid to use them in different contexts;

* To apply relevant writing formats to draft essays, letters, emails and presentations; and

* To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

Course Outcomes:

* Students will be able to analyse a given text and discover the various aspects related to language and literature;

* Learn the various language structures, parts of speech and figures of speech;

* Develop one's reading and writing abilities for enhanced communication; and

* Learn to apply the topics in real-life situations for creative and critical use.

SYLLABUS

Reading: On the conduct of life: William Hazlitt

Grammar: Prepositions

Vocabulary: Word Formation I: Introduction to Word Formation

Writing: Clauses and Sentences

Life skills: Values and Ethics If: Rudyard Kipling

Reading: The Brook: Alfred Tennyson

Grammar: Articles

Vocabulary: Word Formation II: Root Words from other Languages

Writing: Punctuation

Lifeskills: Self-Improvement

How I Became a Public Speaker: George Bernard Shaw

Reading: The Death Trap: Saki

Grammar: Noun-Pronoun Agreement, Subject Verb Agreement

Vocabulary: Word Formations III: Prefixes and Suffixes

Writing: Principals and Good Writing

Life skills: Time Management On saving Time: Seneca

Reading: Chindu Yellama

Grammar: Misplaced Modifiers

Vocabulary: Synonyms, Antonyms

Writing: Essay Writing

Lifeskills: Innovation Muhammad Yunus

Reading: Politics and the English Language: George Orwell

Grammar: Clichés, Redundancies

Vocabulary: Common Abbreviations

Writing: Writing a Summary

Life skills: Motivation

The Dancer with a White Parasol: Ranjana Dave

Textbooks:

1. Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India 2018

Reference Books

1. Practical English Usage, Michael Swan.OUP.1995.
2. Remedial English Grammar, F.T. Wood.Macmillan.2007
3. On Writing Well, William Zinsser. Harper Resource Book. 2001
4. Study Writing, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press.2006.
5. Communication Skills, Sanjay Kumar and PushpLata. Oxford University Press.2011.
6. Exercises in Spoken English, Parts. I-III.CIEFL, Hyderabad. Oxford University Press.

MT1204 CPNM

Course Objectives:

* The course is designed to provide complete knowledge of C language.

* To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

* To provide knowledge to the Students to develop logics which will help them to create programs, applications in C.

* This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

* This course provides the fundamental knowledge which is useful in understanding the other programming languages.

Course Outcomes:

* Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and Apply them in problem solving.

* Apply various operations on derived data types like arrays and strings in problem solving.

* Design and Implement of modular Programming and memory management using Functions, pointers.

* Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.

* Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

Introduction to C: Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

Decision Making, Branching, Looping, Arrays & Strings: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else..if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps

in Loops, One, Two –dimensional Arrays, Character Arrays. Declaration and initialization of strings, reading and writing of strings, String handling functions, Table of strings.

Functions: Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and life time of variables.

Pointers: Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers andarrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications.

Structure and Unions: Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures within structures, structures and functions and unions, size of structures and bit-fields – Program applications.

File handling: Defining and opening a file, closing a file, Input / Output operations on files, Error handling during I /O operations, random access to files and Command Line Arguments Program Applications.

Numerical Methods: Solutions of Algebraic and Transcendental Equations, Bisection Method, Newton Raphson Method. Newton's forwards and backward Interpolation, Lagrange's Interpolations in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules. Solutions and Ordinary First Order Differential Equations: Euler's Method, Modified Euler's Method and Runge-Kutta Method.

Text Book:

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India) Private Limited.

2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

Reference Books:

1. Let Us C,Yashwant Kanetkar, BPB Publications,5th Edition.

2. Computer Science, A structured programming approach using C", B.A. Forouzan and R.F. Gilberg, "3rd Edition, Thomson, 2007.

3. The C–Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.

4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Giovanni Organtini, World Scientific.

MT1205 Industry 4.0

Unit-1: Introduction to Industry 4.0 : Introduction, Idea of Industry 4.0, Various Industrial Revolutions, Origin concept of Industry 4.0,Industry 4.0 Production system, How is India preparing for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory.

Unit-2: Trends in Industry 4.0 : Introduction, Main Concepts and Components of Industry 4.0, State of Art Technologies, Proposed Framework for Industry 4.0, Trends of Industrial Big Data and Smart Business Transformation.

Unit-3: Roadmap for Industry 4.0 : Introduction, Proposed Framework for Technology Roadmap: Strategy Phase, Development Phase, Smart Manufacturing, Types of Smart Devices, Smart Logistics, Smart Cities, Predictive Analytics.

Unit-4: Advances in the Era of Industry 4.0 : Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Things, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly, IIoT- Industrial IoT.

Unit-5: The Role of Industry 4.0 and Future Aspects : Introduction, Challenges & Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

MT 1206 ENGLISH LANGUAGE LAB

Course Objectives:

* To make students recognize the sounds of English through Audio-Visual aids;

* To help students build their confidence and help them to overcome their inhibitions and self-consciousness while speaking in English;

* To familiarize the students with stress and intonation and enable them to speak English effectively

* To give learners exposure to and practice in speaking in both formal and informal contexts.

Course Outcomes:

* Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;

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

* Students will be able to participate in group activities like releplays, group discussions and debates; and

* Students will be able to express themselves fluently and accurately in social as well professional context.

SYLLABUS

Introduction to Phonetics: The Sounds of English (Speech sound–vowels and consonants)-Stress and Intonation - Accent and Rhythm.

Listening Skills: Listening for gist and specific information – listening for Note taking, summarizing and for opinions – Listening to the speeches of eminent personalities.

Speaking Skills: Self-introduction – Conversation Skills (Introducing and taking leave) –Giving and asking for information-Role Play-Just A Minute (JAM)session-Telephone etiquette.

Reading and Writing skills: Reading Comprehension – Précis Writing - E-Mail writing -Punctuation.

Presentation skills: Verbal and non-verbal communication – Body Language Making a Presentation.

Text Books:

1. Ashraf Rizvi. Effective Technical Communication. Tata McGraw Hill Education Private Limited, New Delhi.

2. Speak Well. Orient Blackswan Publishers, Hyderabad.

3. Allan Pease. Body Language. Manjul Publishing House, New Delhi.

MT 1207 CHEMISTRY LAB

Course Objectives:

* To develop the fine skills of quantitative determination of various chemical components through titrimetric analysis

* To develop the skill of green synthesis through the preparation of a polymer/ drug

Course Outcomes:

* The course provides quantitative determination of the amount of various chemical species in solutions by titrations and conduct the quantitative determinations with accuracy

* The course provides to develop novel materials to be used as zeolite and prepare columns for removal of hardness of water

* The course provides a method to synthesise a polymer or a drug

SYLLABUS

1. Determination of Sodium Hydroxide with HCl (Na_2CO_3 Primary Standard)
2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample
3. Determination of percentage of Iron in the given rust solution by external indicator method
4. Determination of total Hardness of Water sample by EDTA method
5. Preparation and analysis of Ion exchange/ Zeolite column for removal of hardness of water
6. Green Synthesis of Polymer/ drug

Reference Books:

1. Vogel's Quantitative Chemical Analysis – V – Edition – Longman.

2. Experiments in Applied Chemistry (For Engineering Students) – Sirita Rattan – S. K. Kataria& Sons, New Delhi

MT 1208 CPNM LAB

* To impart writing skill of C programming to the students and solving problems.

* To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,

* To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.

* This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming Languages.

Course Outcomes:

* Understand various computer components, Installation of software. C programming development environment, compiling, debugging and linking and executing a program using the development environment.

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

* Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.

* Apply and practice logical ability to solve the real world problems.

* Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?
2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs.(e.g., for, while, and do while).
3. Write a set of string manipulation functions e.g., for getting sub-string from a given position, Copying one string to another, Reversing a string, adding one string to another.

4. Write a program which determines the largest and the smallest number that can be stored indifferent data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?

5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.

6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).

7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.

8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.

9. Implement bisection method to find the square root of a given number to a given accuracy.

10. Implement Newton Raphson method to det. A root of polynomial equation.

11. Given table of x and corresponding f(x) values, Write a program which will determine f(x) value at an intermediate x value by using Lagrange's interpolation/

12. Write a function which will invert a matrix.

13. Implement Simpson's rule for numerical integration.

14. Write a program to solve a set of linear algebraic equations.

SYLLABUS -II/IV First semester

MT 2101 METALLURGICALTHERMODYNAMICS–I

Course Objectives:

* The prime aim of this course is to apply thermodynamics to various metallurgical aspects like first law, second law, entropy, and Ellingham Diagrams.

* The course is also intended to understand basics of thermodynamics

Course Outcomes:

* Relate 1st and 2nd Law of thermodynamics

* Knowledge of enthalpy, entropy and free energy.

* Understand the principles of thermodynamics as applied equilibrium positions of chemical reactions.

* Calculate the temperature dependence of rate constants and relate this calculation to activity and fugacity.

* To use Ellingham diagrams for extraction of metals

SYLLABUS

Introduction- Basic concepts in thermodynamics. Objectives and limitations of classical thermodynamics. Zeroth law of thermodynamics.

First Law of Thermodynamics- Forms of Energy, Heat and Work, Joules Experiments, Conservation of Energy, Concept of Maximum Work. Isothermal Expansion, Reversible, Adiabatic Expansion, Constant Pressure Processes, Constant Volume Processes, Enthalpy.

Second Law of Thermodynamics-Efficiency of cyclic process. Carnot cycle. Entropy. Thermodynamic equation of state. Statistical Entropy, Physical Meaning, Boltzman Equation, Mixing Entropy, Stirling's Approximation.

AuxiliaryFunctions- Fundamental Equations of State, Maxwell Relationships. Other Thermodynamics Relations, Chemical Potential, Gibbs – Helmholtz Equation, Criteria of Equilibria.

Third law of Thermodynamics- Heat Capacity and Entropy Changes. Sensible Heats, Transformation Heats, Reaction Heats ÄCp, ÄH=f(T), ÄS=f(T), Adiabatic Flame Temperatures, Heat Balances.

Phase Equilibria in One Component Systems- Clausius - Claperyon Equation, Heats of Vaporization from Vapor Pressure Data, Shift in Transformation Temperature with Pressure. Fugacity, activity and equilibrium constant. Vant Hoff's isotherm. Ellingham diagrams and application.

Textbooks:

1. Introduction to Metallurgical Thermodynamics, David R. Gaskell.

2. Problems in Thermodynamics & Kinetics, G.S. Upadhyaya and R.N. Dubey.

Reference Books:

1. Chemical Metallurgy, J.J. Moore

2. Physical Chemistry of Metals, L.S. Darken and G.Gurry, Tata Mc-Graw hill.

3. Metallurgical Thermodynamics, ML Kapoor Part I&II

4. Metallurgical Thermodynamics, Tupkary

MT 2102 MINERAL BENEFICIATION

Course Objectives:

* Introduce students to the principles of ore comminution, liberation and particle size analysis and equipments used.

* Teach students about various methods of concentration/separation and equipments used.

* Acquaint the students about quantifying concentration processes and selection of proper mineral dressing cycles for an ore/mineral.

Course Outcomes:

* Recognition of the need of the mineral dressing prior to extraction of metals.

* Describe the working and construction details of various equipments used in mineral dressing.

* Assess the efficiency of Concentration processes.

* Select and describe a particular concentration process suitable to the liberated one

SYLLABUS

Objectives and scope: Classification of minerals. An elementary concept of liberation.

Comminution: Study of primary and secondary crushing and grindings units like Jaw, Gyratory, and reduction Gyratory and roll crushers. Theory of Ball Mail operation, Rittinger's, Kick's and Bond's laws of crushing and grinding.

Laboratory sizing units. Screening. Elutriation. Sedimentation. Representation of size analysis data. Sizing equipment used in industry. Elementary concepts of movement of solids in fluids. Stokes and Newtons laws. Reynold's number. Free and hindered settling.Classification and itsapplication in mineral dressing.

Heavy media separation and coal washing Tabling. Jigging. Magnetic and Electro static separation. Elementary treatment of principles of flotation. Surface tension, surface energy, and contactangle. Floatability, frothers, collectors and modifying agents. Differential flotation. Flotation circuits.

Study of basic de-watering techniques like-sedimentation–filtration –drying.

Textbooks:

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

References

1. Mineral Processing Technology, S.K.Jain
2. Unit operation in Chemical Engineering.

MT 2103 IRON MAKING

Course Objectives:

* I llustrate the applications of thermodynamics and kinetics in production of pigironandrefiningit.

* Outline the techniques for production and primary processing in Blast furnace.

* Differentiate between past and present production methods and examine the modern trends in iron production.

* Identify consists and effect for blast furnace irregularities and their remedial measures.

Course Outcomes:

* Identify the required parameters and design of a blast furnace and illustrate ancillary equipment and measures to be taken for starting and trouble shooting of Blast furnace process.

* Predict the physico-chemical phenomena taking place in blast furnace. Able to perform simple mass balance and complex problems.

* Identify and explain the modernization techniques to improve quantity, quality and minimization of waste.

* Able to predict the possible alternative processes to be followed suitable to the local conditions in view of energy, environmental and efficiency considerations.

SYLLABUS

Properties and testing of raw materials: Room temperature and high temperature physical properties, Reducibility tests, factors affecting reducibility.

Blast furnace and accessories: Description of modern blast furnace. Design of blast furnace stoves, Blast furnace refractories, Blast furnace cooling system, Gas cleaning system.

Charging system: Distribution of burden in blast furnace, Blast furnace instruments.

Physical chemistry: Blast furnace physical structure, blast furnace reactions, Distribution of elements in molten metal and slag. Internal and External desulphurization, Blast furnace slag properties and uses. Acid and Basic burdening practices,

Blast furnace operation, irregularities and remedies. Modern developments in blast furnace practice

Alternate routes of pig iron production: Electric arc furnace process, Low shaft furnace, Mini Blast Furnace process, Char coal furnace process. Production of wrought iron.

Textbooks:

1. Introduction to modern iron making, R.H. Tupkary
2. Introduction to modern iron making, A.K. Biswas
3. Physical Chemistry of Iron & Steel Making, C. Bodsworth

References:

1. MSTS-United Steel Corporation, Pittsburgh
2. Blast furnace theory & practice- Vol.I&II, Julius JH. Strysbugen

MT2104 PHYSICALMETALLURGY

Course Objectives:

* The prime objective of this course is to make the student gain an understanding of the relation between micro structural characteristics and properties of metals and alloys.

* The course also critically focuses on the crystallography, phase transformations that occur in several ferrous and nonferrous metallurgical systems as a function of temperature and composition through phase equilibrium diagrams.

Course Outcomes:

* Explain the solidification of metals and alloys, mechanisms.

* Explain the necessity of alloys, will identify the different types of alloy phases.

* Explain the construction and identification of phase diagrams and reactions.

* Explain the Fe-Fe3C diagram with invariant reactions.

* Explain the Cu-Zn and other binary diagrams and complex phase diagrams etc.,

SYLLABUS

Solidification:Solidification of pure metals, alloys and eutectic. Nucleation and growth, Homogenous and Heterogeneous, constitutional super cooling, coring and segregation.

Phase rule, Principles of construction and interpretation of binary phase diagrams: Invariant reactions, Free energy composition diagrams, uses and limitations of phase diagrams.

Equilibrium and non-equlibrium phase diagrams: Fe-C, Cu-Zn, Cu-Sn, Al-Si, Al-Cu, Pb-Sn. Ternary diagrams and interpretation of Structures on cooling.

Diffusion of metals: Fick'slaw, mechanisms of diffusion, solutions to diffusion Equations, diffusion in alloys, Kirkendal effect, Factors affecting, diffusion, grain Boundary diffusion, applications.

Textbooks:

1. Physical Metallurgy - S.H. Avner
2. Physical Metallurgy - V. Raghavan
3. Physical Metallurgy - Vijendra Singh
4. Mechanical Metallurgy - G.E. Dieter

Reference book:

1. Physical Metallurgy - R.E. Reed Hill

MT 2105 MANAGERIAL ECONOMICS

Course Objectives:

* To bring about an awareness about the nature of Managerial Economics and its linkages with other disciplines.

* To understand the Micro and Macro Environment of Business.

* To familiarize the prospective engineers with the concepts and tools of Managerial Economics with an objective to understand the real world of business.

Course Outcomes:

* Understand the various economic activities in business and industry.

* Analyse the real world business problems.

* Make optimal business decisions for the effective and efficient management of Organisations.

SYLLABUS

Significance of Economics and Managerial Economics:

Economics: Definitions of Economics -Wealth, welfare and scarcity definitions classification of Economics - Micro and Micro Economics.

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

Demand and Utility Analysis: Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand –Assumptions and limitations. Exceptional demand curve. Elasticity of demand - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations.

Theory of Production and Cost analysis: Production - Meaning, Production function and its assumptions, use of production function in decision making; Cost analysis- Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. Unavoidable costs, Economies and Diseconomies of scale.

Market Structures : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve; Monopolistic Competition.

Pricing Analysis : Pricing – Significance; Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark-up and Mark-down pricing of retailers. Business cycles - Definition, Characteristics, Phases, Causes and Consequences; Measures to solve problems arising from Business cycles.

TextBooks:

1. Sankaran,S., Managerial Economics, Marghan Publications, 2015, Chennai.

2. Aryasri, A.R., Managerial Economics and Financial Analysis, MC Graw Hill Education, NewDelhi, 2015.

Reference Books:

1. Dwivedi, D.N., Managerial Economics, Vikhas Publishing House Pvt. Ltd. 6thEdition, New Delhi, 2004.

2. Dewett, K.K., Modern Economic Theory, S. Chand & Company Ltd., New Delhi, 2005.

MT 2106 MATERIALS SCIENCE

Course Objectives:

* To describe the basics of crystal structure and its types

* To gain a thorough knowledge about crystal defects

* To impart knowledge about the uses and application of polymers

* Explain the uses and applications of various ceramics

* Describe about the uses and application of various foams

Course Outcomes:

At the end of the course, student will

* Use and apply basics of material science in his own branch of engineering

* Appreciate the importance of polymers and their classification and apply the knowledge for the practical applications.

* Describe the properties of ceramics and choose a particular ceramic for a given application.

* Correlate the structure, property and applications of ceramics and polymers.

SYLLABUS

Introduction: Classification of materials, Space lattice and unit cells,

Crystal systems: Indices for planes and directions. Structures of common metallic materials.

Crystal Defects: Point, Line and surface defects. Dislocations, types, Burgers' Vector. Dislocation movement by slip, climb and cross slip. Dislocation sources. Slip systems for BCC, FCC and HCP metals, Critical resolved shear stress (CRSS) for slip, Twining, Stacking faults Jogs, Kinks

Polymers: Classification, properties and applications, Molecular structure of polymers, Polymerization, Mechanical properties of polymers.

Ceramics: Classification properties and applications, Mechanical properties of Ceramics, Glass and Glass ceramics, Processing of Ceramics

Foams: Classification, properties and applications of foams of metallic, polymer and ceramic

Textbooks:

1. Textbook of Polymer Science; Fred W.Billmeyer, Wiley2007

2. Introduction to Ceramics; Kingery, Bowen, Uhlman. Wiley IndiaPvtLimited,2012

3. Composite Materials: Science and Engineering; Krishan K.Chawla,Springer,2012

MT 2107 MINERAL BENEFICIATION LAB

Course Objectives:

* This laboratory course critically deals with the experiments related to ore dressing principles

* Apart from this,it also concerns about laboratory models of mineral dressing operations

Course Outcomes:

* Pick or take a representative amount of sample and conduct sieve analysis

* Determine the reduction ratio in crushing and grinding of different materials using various size reduction units.

* Analyze the grindability of different coals

* Separate or concentrate the given materials using froth flotation processes

List of experiments:

1. Sampling by coning and quartering and riffle sampler.
2. Determination of average particle size by sieve analysis.
3. Determination of optimum time of sieving.
4. Studies on size reduction using laboratory Jaw Crusher.
5. Studies on size reduction using laboratory Roll Crusher.
6. Studies on size reduction using laboratory Ball Mill.

7. Heavy media separations (sink and float experiment)
8. Laboratory experimentation Froth Flotation.
9. Determination of Grindability of Coal.

MT 2108 MOULDING AND CASTING PRACTICE

Course Objectives:

* To study mould ingredients

* To understand mould making procedures for wet and dry processes

* To know the structural changes and hardness

* To know the problems during melting and casting of pure metals and alloys

Course Outcomes:

* To get moulding skill in various moulding processes

* To Gain knowledge in developing proper melting and casting procedures of various alloys

* To know the structural and property changes on effect of moulding practices of important engineering alloys.

SYLLABUS

Introduction to various mould ingredients and moulding practices of :

1. Wet moudlimg-Bentonite based process
2. Dry moudling-Sodium silicate process

a. CO_2 process

b. Ferrosilicon process Melting and casting practices of:

1. Pure aluminium
2. Al-Cu binary alloys
3. Al-Cu-Mg ternary alloys

Evaluation of Castings:

1. Visual inspection
2. Microstructure studies
3. Hardness survey

MT 2109 PROFESSIONAL LAWS & ETHICS AND UNIVERSAL HUMAN VALUES

Course Objectives:

* To recognize the moral values that should guide the Engineering profession.

* To resolve moral issues concerning one's profession.

* To develop and exhibit a set of moral beliefs and attitudes that engineers should inculcate.

* To inculcate social values and morality in one's life.

* To develop awareness about Professional/Engineering Ethics and Human Values.

Learning Outcomes:

Students will be able to:

* Apply the conceptual understanding of ethics and values into everyday practice.

* Understand the importance of moral awareness and reasoning in life.

* Acquire professional and moral etiquette that an engineer requires.

* Develop the acumen for self-awareness and self-development.

* Develop cultural tolerance and integrity.

* Tackle real-life challenges with empathy.

CONTENTS

Unit - I: HUMAN VALUES : Values - Respect - Caring - Sharing - Honesty-Courage - Self confidence - Communal Harmony Morals - Virtues

Unit –II PROFESSIONAL VALUES : Integrity - Discipline - Valuing time - Cooperation - Commitment - Code of conduct - Challenges in the workplace

Unit – III PROFESSIONAL ETHICS : Overview - Engineering ethics - Moral issues - Profession - Models of professional roles - Responsibility

Unit – IV RESPONSIBILITIES AND RIGHTS : Safety and risk - Collegiality and loyalty - Confidentiality - Occupational crime - Human rights - Employee rights - Intellectual property rights

Unit – V GLOBAL ISSUES : Globalization - Environmental ethics - Computer ethics - Code of ethics - Multinational corporations - Engineers as advisors in Planning and Policy making

Suggested Textbook:

R.S. Nagarazan. A Textbook on Professional Ethics and Human Values. New Age International Publishers. 2006.

Reference Books:

Premvir Kapoor.Professional Ethics and Human Values.Khanna Publishing House. 2019.

B.S. Raghavan. Human Values and Professional Ethics.S.Chand Publications. 2012.

R.R. Gaur & Others.A Foundation Course in Human Values and Proff.Ethics. Excel Books. 2009.

A. N. Tripathi. Human Values.New Age International (P) Limited. 2009

R. Subramanian.Professional Ethics.OUP India. 2013.

MT 2201 HEAT TREATMENT

Course Objectives:

* This course is mainly designed to impart knowledge about basic principles and process variables of different heat treatment processes.

* To understand the techniques of thermo mechanical treatment, surface hardening techniques, heat treatment of steels, cast irons, non ferrous alloys in detail.

* To gain basic knowledge about different types of phase transformations, cooling curves and effect of alloying elements on cooling curves..

Course Outcomes:

* To demonstrate a critical understanding of the importance of heat treatment in achieving fit for purpose in steels

* To apply and interpret phase and continuous cooling diagrams to assess the impact of a range of heat treatment procedures

* To choose and justify a procedure for a particular alloy in order to achieve the properties required for a particular engineering application

SYLLABUS

Phase transformation in Fe-C system, Critical temperatures. Austenite grain size designation. Inherently fine-grained and inherently coarse grained steel. Importance of grain size and its determination. Heat Treatment Furnaces and atmospheres.

T-T-T Curves. Effect of cooling on transformation of austenite, pearlite, bainite and martensite. Annealing, normalizing, hardening and tempering of steels. Austempering and Martempering .Patenting and spheroidizing.

Effect of alloying elements. Hardenability of steels. Factors affecting and its determination. Thermo-mechanical treatments. Ausforming.

Surfacehardening. Carburising, nitriding, cyaniding, carbonitriding. Induction and flame hardening.

Textbooks:

1. Heat Treatment Principles and Techniques - T.V. Rajan, C.P. Sharma and Ashok Sharma Depar
2. Heat treatment of metals, Zakharov

References:

1. Physical Metallurgy, V.Raghavan
2. Introduction to PhysicalMetallurgy, S.H.Avner
3. Physical Metallurgy Principles, R.E. Reed-Hill.
4. Physical Metallurgy for Engineers, Clarkand Varney

MT 2202 : METALLURGICAL THERMODYNAMICS–II

Course Objectives:

* The laws of diffusion.

* Interpret Ellingham diagrams

* Identify metallurgical thermodynamics principles to be applied in phase diagrams.

Course Outcomes:

* Understand and able to use Fick's I and II law.

* Interpret Ellingham Diagram for oxides

* Understand the thermal properties of solids, specifically, specific heat and some models for specific heat calculation.

* Knowledge of ideal and regular solutions and free energy of mixing.

* Apply the phase rule on the metallurgical systems.

* Understanding of the nature of polarized electrochemical reactions and an introduction of their application in corrosion behavior of metals.

SYLLABUS

The Behavior of Gases: Compressibility Factor, Law of Corresponding States, Equations of State, Fugacity. Reactions Equilibria - The effect of temperature and pressure on equilibrium constant.

Equilibria in Gaseous Systems: The Equilibrium Constant and ÄG°, Reaction Extent Problems, Equilibriain Systems Containing Condensed Phases, Ellingham Diagram, Activities.

Solution Thermodynamics - Thermodynamic solutions. Raoult's law. Henry's law. Sievert's law. Absolute and Partial and Integral Molar Quantities, Relative and Partial Integral Molar Quantities, Ideal Solutions, Excess Quantities, Gibb's Duhem Equation, Tangent Intercept Method, a=f(T), Change in Reference State, 1 wt % Reference State Interaction Parameters. Actual solutions. Regular solutions.

Application of the laws of thermodynamics to metallurgical processes, electrochemistry, interfacial phenomena, extraction and refining of materials.

Kinetics of Metallurgical reactions. Collisiontheory. Theory of absolute reaction rates.

Textbooks:

1. Introduction to Metallurgical Thermodynamics, David R. Gaskell.

2. Problems in Thermodynamics & Kinetics, G.S. Upadhyaya and R.N. Dubey.

Reference Books:

1. Chemical Metallurgy, J.J. Moore
2. Physical Chemistry of Metals, L.S.Darken and G.Gurry, TataMc-Graw hill.
3. Metallurgical Thermodynamics, ML Kapoor Part I&II
4. Metallurgical Thermodynamics, Tupkary.

MT 2203 Python programming theory

Course Objectives

1. To develop skills on procedural oriented and object oriented programming in Python
2. To understand and apply different data wrangling techniques using Python.
3. To perform data analysis using python libraries like NumPy, Pandas and exploratory data analysis using Matplotlib

Course Outcomes

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

1. acquire programming knowledge on Basics of Python
2. acquire programming knowledge on Text and File Handling
3. develop Python programs to Mean, Median, Mode, Correlation
4. acquire programming knowledge on NumPy, Pandas Library
5. acquire programming knowledge on Graph Visualizations in Python and Data Analysis using Python

SYLLABUS

1. Introduction to Python: Rapid Introduction to Procedular Programming, Data Types: Identifiers and Keywords, Integral Types, Floating Point Types

Strings: Strings, Comparing Strings, Slicing and Striding Strings, String Operators and Methods, String formatting with str.format

Collections Data Types: Tuples, Lists, Sets, dictionaries, Iterating and copying collections

2. Python Control Structures, Functions and OOP: Control Structures and Functions: Conditional Branching, Looping, Exception Handling, Custom Fuctions

Python Library Modules: random, math, time, os, shutil, sys, glob, re, statistics,creating a custom module

Object Oriented Programming: Object Oriented Concepts and Terminology, Custom Classes, Attributes and Methods, Inheritance and Polymorphism, Using Properties to Control Attribute Access

File Handling: Writing and Reading Binary Data, Writing and Parsing Text Files

3. NumPy Arrays and Vectorized Computation: NumPy arrays, Array creation, Indexing and slicing, Fancy indexing, Numerical operations on arrays, Array functions, Data processing using arrays, Loading and saving data, Saving an array, Loading an array, Linear algebra with NumPy, NumPy random numbers

4. Data Analysis with Pandas: An overview of the Pandas package, The Pandas data structure-Series, The Data Frame, The Essential Basic Functionality: Reindexing and altering labels , Head and tail, Binary operations, Functional statistics , Function application Sorting, Indexing and selecting data, Computational tools, Working with Missing Data, Advanced Uses of Pandas for Data Analysis - Hierarchical indexing, The Panel data

5. Data Analysis Application Examples: Data munging, Cleaning data, Filtering, Merging data, Reshaping data, Data aggregation, Grouping data

6. Data Visualization: The matplotlib API primer-Line properties, Figures and subplots, Exploring plot types-Scatter plots, Bar plots, Histogram plots, Legends and annotations, Plotting functions with Pandas

Text Books

1. Programming in Python 3: A Complete Introduction to Python Language, Mark Summerfield, Second Edition, Addison-Wesley Publications
2. Python: End-to-End Data Analysis Learning Path, Module 1: Getting Started with Python Data Analysis , Phuong VothiHong , Martin Czygan, , Packt Publishing Ltd

Reference Books

1. Learning Python, 5th Edition, Mark Lutz, Orielly Publications
2. Python for Data Analysis, Wes McKinney, Orielly Publications
3. How to Think Like a Computer Scientist: Learning with Python 3 Documentation 3rd Edition, Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers
4. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall
5. Python Cookbook – Recipes for Mastering Python 3,3rdEdition, David Beazley, Brian K. Jones, Oreilly

MT 2204 NON FERROUS EXTRACTIVE METALLURGY–I

Course Objectives:

* To explain the various methods of extraction of non ferrous metals.
* To describe the procedure and equipment used for production of non ferrous metals from their ores.

Course Outcomes:

* Get detailed information about the properties of non ferrous metals, ores of non ferrous metals, pre treatment processes, thermodynamics and kinetics involved in extraction process

* Describe and explain ore treatment techniques and learn the fundamental concepts of metallurgical pre-treatment methods, production of metals from ore, concentrate and secondary sources

* Emphasize the strategic importance of rawand supplementary materials in the production, and explain the concepts of technological and economical feasibility

* Identify the beneficiation of byproducts materialize during the metal production, within the framework of technology-environment-ecology

* Explain processes based on an advanced thermodynamic perspective and explain material and energy flows related to extraction of metals and alloys

* Understand about Extractive metallurgy processes and explain their relative merits and demerits and also Conduct a detailed and individual research about production of a specific metal, as part of their responsibility.

SYLLABUS

Extraction of Metals: Aluminum Uses. Ores. Bayer's process of Alumina production. Hall-Heroult process. Cryolite and carbon electrode manufacture. Hoopes process of refining. Indian plant practice. New processes. Alcoa process.

Magnesium: Uses. Ores. Pidegon's process. Extraction by Dows process.

Tin: Uses. Ores. Concentration, smelting and refining.

Copper: Uses. Pyro-metallurgical processes. New processes. Flash smelting. WORCA and Noranda processes. Hydro-metallurgy of copper. Copper production in India. Nickel: Brief description of Ni extraction from sulphide ores.

Lead: Uses. Ores. Teatment of ore and production of metal.

Zinc: Uses. Pyro-metallurgical and hydro-metallurgical extraction methods. Imperial smelting process.

Textbooks:

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

ReferenceBooks:

1. Metallurgy of Non-Ferrous Metals, Dennis,WH
2. Non-Ferrous Metallurgy, Sebryukov, NMin,Pub.Moscow

MT 2205 MECHANICAL PROPERTIES OF MATERIALS

Course Objectives:

* To gain and understanding of the response of various metals under the application of stress and/or temperature.

* To build necessary theoretical background of the role of lattice defects in governing both elastic and plastic properties of metals will be discussed.

* Obtain a working knowledge of various hardness testing machines BHN,VHN, RHN

* Obtain a working knowledge of creep and fatigue and analysis of data.

Course Outcomes:

* Describe and correlate the structure and mechanical properties of different kind of metals.

* Identify, formulate and solve engineering problems related to mechanical behaviour.

* To know the behavior of material under different loading conditions.

* Demonstrate fracture, and fatigue control on structure.

* Selection of proper testing method to analyze physical structure and hardness of material.

* Knowledge of how to incorporate material strength limitation into engineering design.

SYLLABUS

Introduction: Importance of testing.

Tension test: Engineering stress strain curve. True stress and true strain diagram. Ductility measurements. Typical stress strain diagrams. Yield point phenomenon, strain ageing.

Compression Test: Fundamentals of testing, applications.

Hardness test: Introduction, Brinell, Vickers and Rockwell hardness, Micro hardness.

Fracture: Introduction, types of fracture in metals. Brittle fracture and impact testing: The problems of brittle fracture. Notched bar impact tests, significance of transition temperature, metallurgical factors affecting transition temperature

Creep and stress rupture: The creep curve. Stress rupture test. Structural changes during creep, mechanisms of creep deformation, High temperature alloys, presentation of engineering creep data, prediction of long time properties

Fatigue: Introduction, Stress cycles, S-N diagram, mechanisms of fatigue, Factors influencing fatigue properties, corrosion fatigue, thermal fatigue.

Textbooks:

1. Mechanical Metallurgy, GeorgeEDieter, McGrawHill.
2. Testing of Materials, A.V.K.Suryanarayana, Prentice Hall of India.

Reference Books:

1. Testing of Engineering Materials, Donaldet.al., McGraw Hills.
2. Metals handbook

MT 2206 METALLOGRAPHY LAB

Course Outcomes

* Can describe the metallurgical microscope, sample preparation, mounting and use/choosing of different etching reagents.

* Can identify and report the microstructural features of ferrous and non ferrous samples observed.

* Can operate optical microscope with an ease

* Characterize microstructures of engineering alloys using optical microscopy

SYLLABUS

About 12 experiments on the Metallography of common ferrous and Non-Ferrous metals and alloys, experiments on thermal analysis.

MT 2207 Python programming LAB

Course Objectives

1. familiarize students with key data structures in Python including lists and dictionaries and apply them in context of searching, sorting, text and file handling

2. introduce students to calculation of statistical measures using Python such as measures of central tendency, correlation

3. familiarize students with important Python data related libraries such as Numpy and Pandas and use them to manipulate arrays and data frames

4. introduce students to data visualization in Python through creation of line plots, histograms, scatter plots, box plots and others

5. implementation of basic machine learning tasks in Python including pre-processing data, dimensionality reduction of data using PCA, clustering, classification and cross-validation.

Course Outcomes

After completion of the course the student should be able to:

1. implement searching, sorting and handle text and files using Python data structures such as lists and dictionaries

2. calculate statistical measures using Python such as measures of central tendency, correlation

3. use Python data related libraries such as Numpy and Pandas and create data visualizations

4. implement basic machine learning tasks pre-processing data, compressing data, clustering, classification and cross-validation.

SYLLABUS

1. Python Programs on lists & Dictionaries
2. Python Programs on Searching and sorting
3. Python Programs on Text Handling
4. Python Programs on File Handling
5. Python Programs for calculating Mean, Mode, Median, Variance, Standard Deviation
6. Python Programs for Karl Pearson Coefficient of Correlation, Rank Correlation
7. Python Programs on NumPy Arrays, Linear algebra with NumPy
8. Python Programs for creation and manipulation of Data Frames using Pandas Library
9. Write a Python program for the following.
   * Simple Line Plots,
   * Adjusting the Plot: Line Colors and Styles, Axes Limits, Labeling Plots,
   * Simple Scatter Plots,
   * Histograms,
   * Customizing Plot Legends,
   * Choosing Elements for the Legend,
   * Boxplot
   * Multiple Legends,
   * Customizing Colorbars,
   * Multiple Subplots,
   * Text and Annotation,
   * Customizing Ticks
10. Python Programs for Data preprocessing: Handling missing values, handling categorical data, bringing features to same scale, selecting meaningful features
11. Python Program for Compressing data via dimensionality reduction: PCA

12. Python Programs for Data Clustering

13. Python Programs for Classification

14. Python Programs for Model Evaluation: K-fold cross validation

Reference Books

1. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall

2. Chris Albon, "Machine Learning with Python Cookbook-practical solutions from preprocessing to Deep learning", O'REILLY Publisher,2018

3. Mark Summerfield, Programming in Python 3—A Complete Introduction to the Python Language, Second Edition, Additson Wesley

4. Phuong Vo.T.H , Martin Czygan, Getting Started with Python Data Analysis, Packt Publishing Ltd

5. Armando Fandango, Python Data Analysis, Packt Publishing Ltd

6. Magnus Vilhelm Persson and Luiz Felipe Martins, Mastering Python Data Analysis, Packt Publishing Ltd

7. Sebastian Raschka & Vahid Mirjalili, "Python Machine Learning", Packt Publisher, 2017

MT 2208 WELDING PRACTICE

Course Objectives:

* Study of welding procedures for metals and alloys

* Study of structural changes and hardness

* Study of problems during welding of ferrous and non-ferrous alloys

Course Outcomes:

* Get welding skill in joining various engineering alloys

* Gain knowledge in use of proper procedure in welding of various alloys

* Know the structural and property changes during welding of important engineering alloys

SYLLABUS

Welding procedure : Cleaning, Edge preparation and Selection of welding parameters Shielded Metal arc welding and Gas Tungsten Arc Welding

Welding of mild steel, Welding of Stainless steels, Welding of Aluminium alloy, Welding of Titanium alloy

Identification of various zones Micro structural changes, Hardness survey

Text Books:

1. Welding Technology – RS Parmar

Reference Books:

1. Metal casting and Joining –KC John

MT 2209 ENVIRONMENTAL SCIENCE

Course Objectives:

* Familiarize the fundamental aspects of environment and the environmental management'

* Provide information of some of the important international conventions which will be useful during the future endeavors after graduation.

* Make realize the importance of natural resources management for the sustenance of the life and the society.

* Apprise the impact of pollution getting generated through the anthropogenic activities on the environment

* Provide the concept of Sustainable Development, energy and environmental management

* Impart knowledge on the new generation waste like e-waste and plastic waste.

Course Outcomes:

* Knowledge on the fundamental aspects of environment and the environmental management

* The knowledge on the salient features of the important international conventions

* Understanding of the importance of natural resources management for the sustenance of the life and the society.

* Familiarity on various forms of pollution and its impact on the environment.

* Understand the elements of Sustainable Development, energy and environmental management

* Knowledge on the new generation waste like e-waste and plastic waste.

SYLLABUS

Introduction: Structure and functions of Ecosystems – Ecosystems and its Dynamics-value of Biodiversity – impact of loss of biodiversity, Conservation of bio-diversity. Environmental indicators – Global environmental issues and their impact on the ecosystems.

Natural Resources Management: Importance of natural resources management-Land as resource, Land degradation, Soil erosion and desertification, Effects of usage of fertilizer, herbicides and pesticide-watershed management.

Forest resources: Use and over-exploitation, Mining and dams – their effects on forest ecosystems and the living beings.

Water resources: Exploitation of surface and groundwater, Floods, droughts, Dams: benefits and costs.

Mineral Resources: Impact of mining on the environment and possible environmental management options in mining and processing of the minerals.

Sustainable resource management (land, water, and energy), and resil- ient design under the changing environment.

Environmental Pollution: Local and Global Issues. Causes, effects and control measures. Engineering aspects of environmental pollution control systems.

Air pollution: impacts of ambient and indoor air pollution on human health.Water pollution: impacts water pollution on human health and loss of fresh water resources. Soil pollution and its impact on environment. Marine pollu- tion and its impact on blue economy. Noise pollution.

Solid waste management: Important elements in solid waste manage- ment –Waste to energy concepts. Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act and their amendments. Salient features of Environmental protection Act,1986.

Sustainable Development: Fundamentals of Sustainable Development– Sustainability Strategies and Barriers – Industrialization and sustainable de- velopment. Circular economy concepts in waste(solid and fluid) management.

Energy and Environment: Environmental Benefits and challenges, Avail- ability and need of conventional energy resources, major environmental prob- lems related to the conventional energy resources, future possibilities of en- ergy need and availability. Solar Energy: process of photovoltaic energy con- version, solar energy conversion technologies and devices, their principles, working and applications, disposal of solar panel after their usage. Biomass energy: Concept of biomass energyutilization, types of biomassenergy, con- version processes, Wind Energy, energy conversion technologies, their prin- ciples, equipment and suitability in context of India.

Management of plastic waste and E-waste: Sources, generation and char- acteristics of various e-and plastic wastes generated from various industrial and commercial activities; Waste management practices including onsite handling, storage, collection and transfer. E-waste and plastic waste

processing alternatives. E-Waste management rules and Plastic waste management rules, 2016 and their subsequent amendments.

Text Books:

1. Bharucha, Erach(2004).Textbook for Environmental Studies for Un- dergraduate Courses of all Branches of Higher Education, University Grants Commission, New Delhi.

2. Basu, M.,Xavier,S.(2016). Fundamentals of Environmental Studies, Cambridge University Press, India

3. Masters, G.M.,&Ela,W.P.(1991). Introduction to environmental engi-neering and science. Englewood Cliffs, NJ: Prentice Hall.

4. Enger,E. and Smith,B.,Environmental Science: A Study of Interrela-tionships, Publisher:McGraw-HillHigher Education; 12th edition, 2010.

Reference Books:

1. Sharma,P.D.,&Sharma,P.D.(2005). Ecology and environment. RastogiPublications
2. Agarwal,K.C.2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Clark R.S.(2001). Marine Pollution, Clanderson Press Oxford (TB)
4. Jadhav, H & Bhosale,V.M.(1995). Environmental Protection and Laws.Himalaya Pub.House, Delhi 284 p.
5. MoEF & CC, Govt. of India, CPCB: E-waste management rules,2016and its amendments 2018.
6. MoEF & CC, Govt. of India,CPCB: Plastic waste management rules,2016.