ANDHRAUNIVERSITY

DEPARTMENTOF METALLURGICALENGINEERING

SCHEME AND SYLLABI
(with effect from 2022-2023)

B. Tech I Year-I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
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	Physics Lab	0	3	50	50	100	1.5
MT1108	ES	Fuels Lab	0	3	50	50	100	1.5
Total Credits								**19.5**

B. Tech I Year- II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
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	English Language Lab	0	3	50	50	100	1.5
MT1207	BS	Chemistry Lab	0	3	50	50	100	1.5
MT1208	ES	CPNM Lab	0	3	50	50	100	1.5
Total Credits								**19.5**

B. Tech –II Year-I Semester

Course Code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MT2101	BS	Metallurgical Thermodynamics I	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	Physical Metallurgy	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 Beneficiation Lab	0	3	50	50	100	1.5
MT2108	SC	Moulding and Casting practice	1	2	50	50	100	2
MT2109	MC	Professional Ethics &Universal human values	0	0	0	100	100	0
MT2110	MC	NCC/NSS	0	2	-	-	-	0
Total Credits								**21.5**

B. Tech –II Year-II Semester

Course Code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MT2201	ES	Heat Treatment	4	0	30	70	100	3
MT2202	PC	Metallurgical Thermodynamics II	4	0	30	70	100	3
MT2203	PC	Python programming theory	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	Metallography Lab	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								

B. Tech –III Year-I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MT3101	PC	Foundry Technology	4	0	30	70	100	3
MT3102	PC	Advances in Iron making	4	0	30	70	100	3
MT3103	PC	Non-Ferrous Extractive Metallurgy-II	4	0	30	70	100	3
MT3104	PE	Professional Elective I	4	0	30	70	100	3
MT3105	OE	Open Elective I	4	0	30	70	100	3
MT3106	PC	Heat Treatment Lab	0	3	50	50	100	1.5
MT3107	PC	Metal Casting Lab	0	3	50	50	100	1.5
MT3108	SC	Foundry Practice	1	2	50	50	100	2
MT3109	INT	Internship I			50	50	100	2
Total credits								**22**

B. Tech –III Year-II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MT3201	PC	Metal Forming	4	0	30	70	100	3
MT3202	PC	Environmental degradation of Materials	4	0	30	70	100	3
MT3203	PC	Advances in Steel Making & Production of Ferro Alloys	4	0	30	70	100	3
MT3204	PE	Professional Elective II	4	0	30	70	100	3
MT3205	OE	Open Elective II	4	0	30	70	100	3
MT3206	PC	Electro-Metallurgy lab	0	3	50	50	100	1.5
MT3207	PC	Materials processing lab	0	3	50	50	100	1.5
MT3208	PC	NDT Lab	0	3	50	50	100	1.5
MT3209	SC	Soft Skills	1	2	50	50	100	2
Total credits								**21.5**
Internship I I								

B. Tech –IV Year-I Semester

Course code	Category	Course Title	Hours Per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
MT4101	PE	Professional Elective III	4	0	30	70	100	3
MT4102	PE	Professional Elective IV	4	0	30	70	100	3
MT4103	PE	Professional Elective V	4	0	30	70	100	3
MT4104	OE	Open Elective III	4	0	30	70	100	3
MT4105	OE	Open Elective IV	4	0	30	70	100	3
MT4106	HSSE	HSS Elective	4	0	30	70	100	3
MT4107	SC	Advanced Materials processing	1	2	50	50	100	2
MT4108	INT	Internship II			50	50	100	2
Total credits								**22**

B. Tech-IV Year-II Semester

Course code	Category	Course Title	Internal Marks	External Marks	Total Marks	Credits
MT4201	PROJ	Project work,	100	100	200	14
					Total credits	**14**

List of Professional Electives

1.	Steel Making
2.	Composite materials
3.	Strengthening mechanisms
4.	Engineering Materials
5.	Nano materials
6.	Functional materials
7.	Energy materials
8.	Biomaterials
9.	Electronic materials
10.	Fatigue and fracture mechanics
11.	Computational Materials engineering
12.	Surface Engineering
13.	Phase transformations
14.	Introduction to transport phenomenon
15.	Physics of Materials

List of Open Electives

1.	Materials Characterization
2.	Metal Joining processes
3.	Powder Metallurgy
4.	Failure Analysis
5.	Introduction to materials Engineering
6.	Materials Thermodynamics
7.	Iron making and Steel making Technology
8.	Materials processing
9.	Introduction to Instrumentation
10.	Fluid Mechanics and Heat Transfer
11.	Engineering Mechanics & Strength of Materials
12.	Electrical Technology

List of HSS Electives

1	Organizational Behaviour
2	Industrial Management and Entrepreneurship
3	Operations Research

MT1101 MATHEMATICS-I

Course Objectives:

- TotransmittheknowledgeofPartialdifferentiation.
- Toknowofgettingmaximaandminimaoffunctionoftwovariablesandfindingerrorsandapproximations.
- Toevaluatedouble andtripleintegrals,volumes of solidsandareaofcurvedsurfaces.
- ToexpandaperiodicalfunctionasFourierseriesandhalf-rangeFourierseries.

Course Outcomes:

- Findthepartialderivativesoffunctionsoftwoormorevariables.
- Evaluatemaximaandminima,errors and approximations.
- Evaluatedoubleandtripleintegrals,volumesofsolidsandareaofcurvedsurfaces.
- ToexpandaperiodicalfunctionasFourierseries andhalf-range Fourierseries.
- HaveafundamentalunderstandingofFourierseriesandbeabletogiveFourierexpansionsof agiven 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.

Text Book:

1.ScopeandTreatmentasin"HigherEngineeringMathematics",byDr.B.S.Grewal,43rdEdition,Khannapublishers.

Reference Books:

1. GraduateEngineeringMathematicsbyVBKumarVatti.,I.K.InternationalpublishinghousePvt. Ltd.
2. AdvancedEngineeringMathematicsbyErwinKreyszig.
3. AtextbookofEngineeringMathematics,byN.P.BaliandDr.ManishGoyal,LakshmiPublications.
4. AdvancedEngineering MathematicsbyH.K. Dass.S.ChandCompany.
5. HigherEngineeringMathematicsby B.V.Ramana,Tata McGraw HillCompany.
6. HigherEngineeringMathematicsbyDr.M.K.Venkataraman.

MT1102PHYSICS

Course Objectives:

- Toimpartknowledgeinbasicconceptofphysicsof Thermodynamicsrelevanttoengineeringapplications.
- Tograsptheconceptsofphysicsforelectromagnetismanditsapplicationtoengineering.Learnproduction ofUltrasonics andtheirapplications in engineering.
- ToDevelopunderstandingofinterference,diffractionandpolarization:connectittoafewengineering applications.
- ToLearnbasicsoflasers andopticalfibersandtheiruseinsomeapplications.
- ToUnderstandconceptsandprinciplesinquantummechanicsandNanopahseMaterials.Relatethem 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 usingTimeindependentoneDimensionalSchrodinger'swaveequation.Understandthefundamentalsand synthesis processes ofNanophasematerials.

SYLLABUS

Thermodynamics: Introduction,HeatandWork,Firstlawofthermodynamicsandapplications, Reversible and Irreversible process,Carnot cycleandEfficiency, Secondlaw ofthermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy anddisorder,Third lawof thermodynamics (statement only).

Electromagnetism: Concept of electric flux, Gauss's law - some applications, Magnetic field - Magneticforceoncurrent,torqueoncurrentloop,TheBiot-Savart'sLaw,Bnearalongwire,B

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

Ultrasonic: Introduction,ProductionofUltrasonic– PiezoelectricandMagnetostrictionmethods,acoustic grating, applications of Ultrasonic.

Optics-Interference: Principlesofsuperposition–Young'sExperiment–Coherence-Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and itsapplications.

Diffraction: Introduction,Differencesbetweeninterferenceanddiffraction,FresnelandFraunhoferdiffraction,Fraunhoferdiffractionatasingleslit**(**Qualitativeandquantitativetreatment**)**.

Polarization: Polarization by reflection, refraction and double refraction in uniaxial crystals,Nicolprism, QuarterandHalf waveplate, circular andelliptical 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 uncertaintyprinciple, Schrodinger time independent wave equation, application to a particle in a box. Freeelectron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy bandformationinsolids,Classificationofmaterialsintoconductors,semiconductorsandinsulators.

NanophaseMaterials: Introduction,properties,Top-downandbottomupapproaches,Synthesis - Ball milling, Chemical vapour deposition method , sol-gel methods, Applications ofnanomaterials.

Text Books :

1. PhysicsbyDavidHalliday andRobertResnick– PartIandPartII-Wiley.
2. Atextbookof EngineeringPhysics,Dr. M.N.Avadhanulu, Dr.P.G.Kshirsagar-S. Chand
3. EngineeringPhysicsbyR.K.GaurandS.L.Gupta –DhanpatRai

Reference Books:

1. ModernEngineeringPhysicsbyA.S.Vadudeva
2. UniversityPhysicsbyYoungandFreedman

M**T1103ENGINEERINGGRAPHICS**

Course Objectives:

- UnderstandthebasicsofEngineeringGraphicsandBISconventions.
- Developthegraphicalskillsforcommunicationofconcepts,ideasanddesignofengineeringproduct sthrough technical drawings
- Demonstrateandpracticethevariousprofiles/curvesusedinengineeringpracticethroughstandardp rocedures.
- Demonstrateandpracticetheorthographicprojectionsofpoints,lines,planes,solidsandsectionofso lids
- Demonstrateandpractice thedevelopmentofsurfacesofsimplesolids
- Familiarizethebasicconceptofisometricviewsclearly.

Course Outcomes:

- DevelopsimpleengineeringdrawingsbyconsideringBISstandards.
- AbletodrawdifferentengineeringcurveswithstandardProcedures
- Comprehendthebasicsoforthographicprojectionsanddeduceorthographicprojectionsofpoints,li nes, planesand solids atdifferent orientations inreal lifeenvironment.
- Visualizeclearlythesectionsof solids.
- Applytheconceptsofdevelopmentofsurfaceswhiledesigning/analyzinganyproduct.
- Recognizethesignificanceofisometricdrawingtorelate2Denvironmentwith3Denvironment.

SYLLABUS

Introduction: Lines,LetteringandDimensioning,GeometricalConstructions,andScales.

Curves: Conic sections,General construction of ellipse, parabola andhyperbola. Constructionofinvolutes of circle andpolygons only.Normaland tangent to curves.

Projections of Points: Principal or Reference Planes, Projections of a point situated in any oneof thefourquadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes,perpendiculartoonereferenceplaneandparalleltootherreferenceplane,inclinedtoonereferenc eplane and parallel to theotherreferenceplane.

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 planeandparalleltoother reference plane andperpendicular toone reference planeand inclined to other reference plane. Projection of Oblique planes.Introduction to AuxiliaryPlanes.

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 planeand Axis parallel to both the reference planes, Projection of Solids with axis inclined to onereferenceplane andparallel 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

linedevelopment.Development of a cube,prism, cylinder, pyramid andcone.

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

Text Book:

1. ElementaryEngineeringDrawingbyN.D.Bhatt,CharotarPublishingHouse.

Reference Book:

2. EngineeringGraphicsby K.L.Narayana andP.Kannaiah,TataMc-Graw Hill

M**T1104PRINCIPLESOFEXTRACTIVEMETALLURGY**

Course Objectives:

- To learn and emphasize the Principles of Pyrometallurgy, hydrometallurgy andelectrometallurgy.
- Tolearnscientificconceptsofextractionandrefining
- Obtain knowledge of equipment used in Pyrometallurgy, hydrometallurgy andelectrometallurgy

Course Outcomes:

- Classifyanddescribetheextractionroutesofpyrometallurgy,hydrometallurgyandelectrometallurgy.
- ToIllustratewiththehelpofflowsheetofprocesstakingplaceinpyrometallurgy,hydrometallurgyand electrometallurgical extractions of metal/matte.
- Choosethetypeofrefiningprocess accordingpurityrequired.
- Understandtheimpactofextractiveprocessonhealthenvironmentsocietyandwillbeabletosuggestsuitabletechniquestorecycle thebyproductsortodecrease energy consumptions.
- Designthesuitableprocess forextractions.

SYLLABUS

GeneralMethodsofExtraction.Pyro-metallurgy: Roasting,Typesof roasting,Roastingequipmentand methods,Predominanceareadiagrams,Smelting, Smeltingfurnaces.

HydroMetallurgy: Advantagesanddisadvantages,Principlesofleaching,Leachingkineticsandfactors affecting.

ElectroMetallurgy-classification.Principlesofrefining.Useofvacuum,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, cokeandlimestone.Preparationofironores:MethodsofBeneficiation,Agglomerationof 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 sinteringandpelletisation plants.

Text books:

1. Introductiontomoderniron making,R.H.Tupkary
2. Introductiontomodernironmaking,A.K.Biswas
3. PhysicalChemistryofIron&SteelMaking,C.Bodsworth
4. ExtractionofNon-FerrousMetals,H.S.Ray,R.SridharandK.P.Abraham

Reference Books:

1. MSTS-UnitedSteelCorporation,Pittsburgh
2. Blastfurnacetheory&practice- Vol.I& II,JuliusJH.Strysbugen
3. MetallurgyofNon-FerrousMetals, Dennis,W.H.
4. Non-FerrousMetallurgy,Sebryukov,N.Min, Pub.Moscow

MT1105FUELS,REFRACTORIESANDFURNACES

Course Objectives:

- Thiscourseismainlyintendedtodemonstratethesignificanceandcharacterizationofconventionalfuels that areemployed in metallurgicalprocesses.
- Gainanunderstandingof manufacture,testing,andapplicationsofrefractories.
- Togainknowledgerelatedtoworking principlesoffurnacesusedinmetallurgicalindustries.
- Toexplainconstruction,salientfeaturesandheattransferaspectsofvarious furnaces.

Course Outcomes:

- Know about a fuel, classify them and compare different types of fuels and describe theirtestingmethods.Explainthecokemakingprocess,listouttheproperties anditsby-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 applyanalytical techniquestothesolution ofconduction 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 inherent propertiesoftherefractory mineraland howit affectstheproductiontechnology andtheapplication.

SYLLABUS

Solid fuels:

ClassificationProximateanalysis&ultimateanalysisofcoal.Carbonizationofcoal.Cokemaking and byproductsrecovery.Testing and properties ofcoke.

Liquid fuels: Classification.Petroleumrefining.Distillation.

Gaseousfuels:Classification.ProductionofPG,WG,CWG,LDgas,CokeovengasandBFgas.

Refractories: Properties, classification and general description.Manufacture, properties andapplications of Alumino-silicate, Silica, Dolomite, Magnesite, Chromite and Carbon refractories.Importance and study of SiC, $ZrO_2$and cermets.Testing ofrefractories.

Elementsofheattransmission: Steadystateconduction,convectionand radiation.

Furnaces. Classification of furnaces and their use in metallurgical industries.Heat sources, Heatutilization in furnaces, Heat losses in furnaces and furnace efficiency.Heat balance and Sankeydiagrams.Principlesofwasteheatrecovery.Recuperatorsandregenerators.Protectiveatmospheres.

Textbooks:

1. Fuels,furnacesandrefractoriesbyO.P.Gupta
2. ExperimentalmethodsforEngineers,J.P.Holman, McGrawHillPublication.

ReferenceBooks:

1. Fuels,TechnologybyHinues
2. FuelsbyGilchrist
3. RefractoriesbyChesty

MT1106 WORKSHOP

CourseObjectives:

- Theengineeringworkshoppracticeisincludedtointroducesomecommonshoppractices and on hands on experience to appreciate the use of skill, tools, equipment andgeneralpractices to all the engineering students.
- This laboratory course is aimed to provide the practical exposure to the students in thefieldsof Carpentry, Fitting, Sheet Metaland houseelectrical wiring worksto
- Gethandsonexperience withtheworkingskillsinCarpentry trade.
- Knowhowto workwithSheet Metaltools.
- GetfamiliarwiththeworkingskillsofMetalFittingoperations.
- Gethands onexperiencewithhouseholdelectrical wiring.

CourseOutcomes:

- Canbeableto workwithWoodMaterials inrealtimeapplications.
- Canbeabletobuildvarious partswithSheetMetalinday-to-day life.
- Canbeableto applyMetalFittingskills invariousapplications.
- Canbeable toapply thisknowledgetobasichouseelectricalwiring andrepairs.

SYLLABUS

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

SheetMetal: Anythreejobsfrom –Squaretray,Tapertray(sides), Funnel,Elbowpipejoint.

Fitting: Anythreejobsfrom –Square,Hexagon,Rectangularfit, Circular fitandTriangular fit.

Housewiring: Anythreejobsfrom–Tubelightwiring,Ceilingfanwiring,Stair-casewiring,Corridorwiring.

TextBooks:

1. Elementsof workshoptechnology, Vol.1by S.K. and H.K. Choudary.
2. WorkshopManual/P.Kannaiah/K.L.Narayana/SciTechPublishers.
3. EngineeringPracticesLabManual,Jeyapoovan,SaravanaPandian,4/eVikas.

MT1107PHYSICSLAB

CourseObjectives:

- Toenablethestudentstoacquireskill,technique andutilizationofthe Instruments
- Drawtherelevancebetweenthetheoreticalknowledgeandtoimplyitinapracticalmannerwith respectto analyzevariouselectroniccircuits andits components.
- Toimpartthepracticalknowledgeinbasicconceptsof Waveoptics,LasersandFiberoptics.
- Tofamiliarizethehandlingofbasicphysicalapparatuslike Vernier callipers,screwgauge,
- spectrometers,travelling microscope,laserdevice, opticalfibre,etc.

CourseOutcomes:

- Abilitytodesignandconductexperimentsas wellastoanalyzeandinterpret
- Abilitytoapplyexperimentalskillstodeterminethephysicalquantitiesrelatedto Heat,Electrom agnetismand Optics
- Thestudentwilllearntodrawtherelevancebetweentheoreticalknowledgeandthemeanstoimpl y itin apractical mannerby performingvarious relativeexperiments.

ListofExperiments:

1. DeterminationofRadiusofCurvatureofagiven ConvexLensByformingNewton'sRings.
2. DeterminationofWavelengthofSpectralLinesintheMercurySpectrumbyNormalIncidencemeth od.
3. StudytheIntensityVariationoftheMagneticFieldalongaxisofCurrentCarryingCircularCoil.
4. DeterminationofCauchy'sConstantsofaGiven MaterialofthePrismusingSpectrometer.
5. DeterminationofRefractiveIndexofOrdinaryray$\mu_o$andExtraordinaryμ_e ray.
6. DeterminationofThicknessGivenPaperStripby WedgeMethod.
7. CalibrationofLowRangeVoltmeter.
8. CalibrationofLowRangeAmmeter.
9. DeterminationofMagneticMomentandHorizontalComponentofEarth's MagneticField.
10. LeesMethod-Coefficient ofthermalConductivity ofaBadConductor.
11. CareyFoster'sBridge– VerificationoflawsofResistanceandDeterminationOfSpecificResistance.
12. Melde'sApparatus–FrequencyofelectricallymaintainedTuningFork.
13. Photoelectriccell-Characteristics.
14. PlanksConstants.
15. Laser-Diffraction.

MT1108FUELS LAB

CourseObjectives: At theend ofthe coursethe studentis expected to

- Toknowtheproceduresofdeterminingvariouspropertiesoffuels
- Togetfamiliarizedwiththehandlingofequipmentcaloriemetersandviscometers

CourseOutcomes:

- Abilitytoconductexperimentsrelatedtofuel properties
- Abilitytogain experimentalskillstodeterminethe calorificvalueandviscosityofgivenfuel sample

Listofexperiments:

1. Determinationof Flashandfirepointsofoils.(Opencup)
2. Determinationof Flashandfirepointsofoils(Closedcup)
3. DeterminationofCalorificvalueoffuels(solids,liquids)byBombcalorimeter
4. 4.DeterminationofCalorific valueoffuels(gaseous)bygas calorimeter.
5. TodeterminethekinematicandabsoluteviscosityofthegivensampleoilusingRedwoodViscometerI.
6. TodeterminethekinematicandabsoluteviscosityofthegivensampleoilusingRedwoodViscometer II.
7. Determinationofcarbon residue.

SYLLABUS -I/ IVSECONDSEMESTER

MT1201MATHEMATICS-II

CourseObjectives:

- Thewayofobtaining rank, eigenvalues andeigen vectors ofamatrix.
- ToknowtheimportanceofCayley-Hamiltontheoremandgettingcanonicalformfromagivenquadraticform.
- Tosolvethesystem ofequationsbyusing directandindirectmethods.
- Tosolvefirst order andhigherorderdifferentialequations byvariousmethods.
- To obtain the Laplace transforms and inverse Laplace transforms for a given functionsandtheirapplications.

CourseOutcomes:

- Find rank, eigen values and eigen vectors of a matrix and understand the importance ofCayley-Hamiltontheorem.
- Reduce quadratic form to canonical forms and solving linear systems by direct andindirectmethods.
- Demonstrate solutions to first order differential equations by various methods and solvebasicapplicationsproblemsrelatedtoelectricalcircuits,orthogonaltrajectoriesandNewton'slawof cooling
- Discriminateamongthestructureandprocedureofsolvinghigherorderdifferentialequationswith constant and variable coefficients.
- Understand Laplace transforms and its properties and finding the solution of ordinarydifferentialequations.

SYLLABUS

Linear Algebra: Rank of a matrix- Echelon form, Normal Form - Solution of Linear System ofEquations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gausseliminationmethod,LUFactorizationmethod,GaussSeidalMethod.ComplexMatrices:Hermitian,Skew-Hermitian and UnitaryMatricesand theirProperties.

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 itsapplications.Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form toCanonicalForm -Natureof aQuadraticForm.

Ordinary Differential Equations of First Order and its Applications: Formation of ordinarydifferential equations (ODEs) - Solution of an ordinary differential equation - Equations of thefirstorderandfirstdegree-Lineardifferentialequation-Bernoulli'sequation-Exactdifferential equations - Equations reducible to exact equations - Orthogonal Trajectories - SimpleElectric(LR&CR)Circuits-Newton'sLawofCooling -LawofNaturalgrowthanddecay.

Differential Equations of Higher Order: Solutions of Linear Ordinary Differential Equationswith Constant Coefficients - Rules for finding the complimentary function - Rules for finding theparticular integral - Method of variation of parameters - Cauchy's linear equation - Legendre'slinearequation -Simultaneous lineardifferentialequations.

LaplaceTransforms: Introduction-ExistenceConditions-TransformsofElementaryFunctions - Propertiesof Laplace Transforms- Transforms of Derivatives- Transforms ofIntegrals - Multiplication by t^n - Division by t – Evaluation of integrals by Laplace Transforms - InverseLaplaceTransform-ApplicationsofLaplaceTransformstoOrdinaryDifferentialEquations - Simultaneous Linear Differential Equations with Constant Coefficients - SecondShifting Theorem- Laplace Transforms of Unit Step Function, Unit Impulse Function andLaplace Transforms ofPeriodicFunctions.

TextBook:

1.ScopeandTreatmentasin"HigherEngineeringMathematics",byDr.B.S.Grewal,43rdedition,Khannapublishers.

ReferenceBooks:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing housePvt. Ltd.
2. AdvancedEngineeringMathematicsbyErwinKreyszig.
3. AtextbookofEngineeringMathematics,byN.P.BaliandDr.ManishGoyal.LakshmiPublications.
4. AdvancedEngineering MathematicsbyH.K. Dass.S.ChandCompany.
5. HigherEngineeringMathematicsby B.V.Ramana,Tata McGraw HillCompany.

MT1202GREEN 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 aspectsof 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.

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

CourseObjectives:

- Tomakestudents understandtheexplicitand implicitmeaningsof atext/topic;
- Togiveexposuretonewwordsand phrases,andaid tousethemin differentcontexts;
- Toapplyrelevantwritingformatstodraftessays,letters,emailsandpresentations;and
- Toadaptoneselftoagivensituationanddevelopafunctionalapproachtofindingsolutions:adapt ability and problem solving.

CourseOutcomes:

- Studentswillbeabletoanalyseagiventextanddiscoverthevariousaspectsrelatedtolanguagean d literature;
- Learnthevariouslanguagestructures,parts ofspeechand figuresof speech;
- Developone'sreadingandwritingabilitiesforenhancedcommunication;and
- Learntoapplythetopicsinreal-lifesituationsforcreative andcriticaluse.

SYLLABUS

Reading: Ontheconduct oflife:WilliamHazlitt
Grammar: Prepositions
Vocabulary: WordFormationI: IntroductiontoWordFormation
Writing: Clauses and
Sentences**Life skills: Values**
and EthicsIf: Rudyard Kipling

Reading: TheBrook:AlfredTennyson
Grammar: Articles
Vocabulary: WordFormationII:RootWordsfromotherLanguages
Writing: Punctuation
Lifeskills:Self-Improvement
How IBecame aPublic Speaker:GeorgeBernard Shaw

Reading: TheDeathTrap: Saki
Grammar: Noun-Pronoun Agreement, Subject- Verb
Agreement**Vocabulary:**
WordFormationIII:PrefixesandSuffixes**Writing:**Principals of
Good Writing
Life skills: Time
ManagementOn saving Time:
Seneca**Reading:**
ChinduYellama**Grammar:**Mispl
acedModifiers
Vocabulary: Synonyms,Antonyms
Writing: EssayWriting
Lifeskills:Innovation MuhammadYunus

Reading: PoliticsandtheEnglishLanguage:GeorgeOrwell
Grammar: Clichés,
Redundancies**Vocabulary:** Common
Abbreviations**Writing:**Writing
aSummary
Lifeskills:Motivation
TheDancerwithaWhite Parasol:RanjanaDave

Textbooks:

1. LanguageandLife:ASkillsApproachBoardofEditors,OrientBlackswanPublishers,India.2018.

ReferenceBooks

2. PracticalEnglishUsage, MichaelSwan.OUP.1995.
3. RemedialEnglishGrammar,F.T. Wood.Macmillan.2007
4. OnWritingWell,WilliamZinsser.HarperResourceBook.2001
5. StudyWriting,LizHamp-LyonsandBenHeasly.CambridgeUniversityPress.2006.
6. CommunicationSkills,SanjayKumarandPushpLata.OxfordUniversityPress.2011.
7. ExercisesinSpokenEnglish,Parts.I-III.CIEFL, Hyderabad.OxfordUniversityPress.

MT1204 CPNM

CourseObjectives:

- Thecourseis designedto providecomplete knowledgeof C language.
- To provide students with understanding of code organization and functional hierarchicaldecompositionwith using complex data types.
- To provide knowledge to the Students to develop logics which will help them to createprograms,applications inC.
- Thiscourseaimstoidentifytasksinwhichthenumericaltechniqueslearnedareapplicable and apply them to write programs, and hence use computers effectively tosolve thetask.
- This course provides the fundamental knowledge which is useful in understanding theotherprogramming languages.

CourseOutcomes:

- IdentifybasicelementsofCprogrammingstructureslikedatatypes,expressions,controlstatements,various simplefunctions and Applythem inproblem solving.
- Applyvariousoperationsonderiveddatatypeslikearraysandstringsinproblemsolving.
- DesignandImplementofmodularProgrammingandmemorymanagementusingFunctions,pointers.
- ApplyStructure,UnionsandFilehandlingtechniquestoDesignandSolvedifferentengineering programs with minimal complexity.
- ApplyNumericalmethodstoSolve thecomplexEngineeringproblems.

SYLLABUS

Introduction to C: Basic structure of C program, Constants, Variables and data types, Operatorsand Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing InputandOutput Operations FormattedInput, 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,Theforstatement,JumpsinLoops,One,Two-dimensionalArrays,CharacterArrays.DeclarationandinitializationofStrings,readingandwritingofstrings,Stringhandlingfunctions, Tableofstrings.

Functions: Definition of Functions, Return Values and their Types, Function Calls, FunctionDeclaration, Category of Functions: No Arguments and no Return Values, Arguments but noReturnValues,ArgumentswithReturnValues,NoArgumentbutReturnsaValue,Functionsthat Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passingstringsto functions, thescope, visibility andlifetime ofvariables.

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

Structure and Unions: Defining a structure, declaring structure variables, accessing structuremembers,structureinitialization,copyingandcomparingstructurevariables,arraysofstructures, arrays within structures, structures within structures, structures and functions andunions,sizeof structuresand bit-fields-Programapplications.

Filehandling: Definingandopeningafile,closingafile,Input/Outputoperationsonfiles,Error handling during I/O operations, random access to files and Command Line Arguments-ProgramApplications

Numerical Methods: Solutions of Algebraic and Transcendental Equations, Bisection Method,NewtonRaphsonMethod.Newton'sforwardandbackwardInterpolation,Lagrange'sInterpolation in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules.Solutions of Ordinary First Order Differential Equations: Euler's Method, Modified Euler'sMethodand Runge-KuttaMethod.

TextBook:

1. ProgramminginANSIC,EBalagurusamy,6thEdition.McGrawHillEducation(India)PrivateLimited.
2. IntroductiontoNumericalMethods,SSSastry,PrenticeHall

ReferenceBooks:

1. LetUsC,YashwantKanetkar,BPBPublications,5thEdition.
2. ComputerScience,AstructuredprogrammingapproachusingC",B.A.ForouzanandR.F.Gilberg," 3rd Edition, Thomson,2007.
3. TheC–ProgrammingLanguage'B.W.Kernighan,DennisM.Ritchie,PHI.
4. ScientificProgramming:C-Language,AlgorithmsandModelsinScience,LucianoM.Barone(Author), EnzoMarinari(Author), Giovanni Organtini,World Scientific.

MT1205industry 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.

MT1206ENGLISHLANGUAGELAB

CourseObjectives:

- To makestudents recognizethe sounds ofEnglish through Audio-Visual aids;
- Tohelpstudentsbuildtheirconfidenceandhelpthemtoovercometheirinhibitionsandself-consciousness whilespeaking in English;
- To familiarize the studentswithstressand intonation and enable themto speak Englisheffectively
- Togivelearnersexposuretoandpracticeinspeakinginbothformalandinformalcontexts.

CourseOutcomes:

- StudentswillbesensitizedtowardsrecognitionofEnglishsoundpatternsandthefluencyintheir speech will beenhanced;
- Astudyofthecommunicativeitemsinthelaboratorywillhelpstudentsbecomesuccessfulin the competitiveworld;
- Studentswillbeabletoparticipateingroupactivitieslikeroleplays,groupdiscussionsanddebates; and
- Studentswillbeabletoexpressthemselvesfluentlyandaccuratelyinsocialaswellprofessionalcontext.

SYLLABUS

IntroductiontoPhonetics: TheSoundsofEnglish(Speechsound–vowelsandconsonants)-StressandIntonation-Accent and Rhythm.

ListeningSkills: Listeningforgistandspecificinformation-listeningforNotetaking,summarizingand for opinions -Listening tothe speeches of eminentpersonalities.

SpeakingSkills:Self-introduction-ConversationSkills(Introducingandtakingleave)-Givingandasking forinformation-Role Play-JustA Minute(JAM)session-Telephoneetiquette.

ReadingandWritingskills: ReadingComprehension–PrécisWriting-E-Mailwriting-Punctuation.

Presentationskills:Verbalandnon-verbalcommunication-BodyLanguage-MakingaPresentation.

TextBooks:

1. AshrafRizvi.*EffectiveTechnicalCommunication*.TataMcGrawHillEducationPrivateLimited, New Delhi.
2. *SpeakWell*.OrientBlackswanPublishers,Hyderabad.
3. AllanPease.*BodyLanguage*.ManjulPublishingHouse,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 Ionexchange/ 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) – Sinita Rattan – S. K.Kataria& Sons, New Delhi

MT 1208 CPNM LAB

- Toimpartwriting skillof C programming tothe studentsand solvingproblems.
- TowriteandexecuteprogramsinCtosolveproblemssuchasModularizetheproblemsintosmall modules and then convertthem into programs.,
- TowriteandexecuteprogramsinCtosolveproblemssuchasarrays,files,strings,structuresand different numerical methods.
- Thisreferencehasbeenpreparedforthebeginnerstohelpthemunderstandthebasictoadvancedc oncepts related to Objective-CProgramming languages.

CourseOutcomes:

- Understandvariouscomputercomponents,Installationofsoftware.Cprogrammingdevelopme nt environment, compiling, debugging, and linking and executing a programusingthe development environment.
- Analyzing the complexity of problems, Modularize the problems into small modules andthenconvert them into programs.
- Construct programs that demonstrate effective use of C features including arrays, strings,structures,pointers andfiles.
- Applyandpracticelogicalability tosolvetherealworldproblems.
- ApplyNumericalmethods toSolve thecomplexEngineeringproblems.

SYLLABUS

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangleformedbythemandprintthecoordinatesofthethreepointsandtheareaofthetriangle.Whatw ill betheoutput from yourprogramif thethreegivenpoints arein a straight line?
2. Writeaprogram,whichgenerates100randomintegersintherangeof1to100.Storethemin an array and then print the arrays. Write 3 versions of the program using different loopconstructs.(e.g.for, while, and do while).
3. Writeasetofstringmanipulationfunctionse.g.forgettingasub-stringfromagivenposition,Copying one stringto another, Reversingastring, addingonestring toanother.
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 tothelargest possibleinteger number thatcan bestored?
5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, andsortthem in descendingorder.
6. Write a function for transposing a square matrix in place (in place means that you are notallowedto havefull temporary matrix).
7. First use an editor to create a file with some integer numbers. Now write a program, whichreadsthesenumbers anddetermines their mean andstandard deviation.
8. Given two points on the surface of the sphere, write a program to determine the smallest arclengthbetween them.
9. Implementbisectionmethodto findthesquarerootofagivennumberto agivenaccuracy.
10. ImplementNewtonRaphsonmethodtodet.arootof polynomialequation.
11. Giventableofxandcorrespondingf(x)values,Writeaprogramwhichwilldeterminef(x)valueat an intermediatex valueby using Lagrange's interpolation/
12. Writeafunctionwhich will invertamatrix.
13. ImplementSimpson'srulefornumericalintegration.
14. Writeaprogramtosolveasetoflinear algebraicequations.

SYLLABUS -II/IVFirstsemester

MT2101METALLURGICALTHERMODYNAMICS–I

CourseObjectives:

- Theprimeaimofthiscourse istoapplythermodynamicstovariousmetallurgicalaspectslikefirst law, second law, entropy, and EllinghamDiagrams.
- Thecourseisalsointendedto understandbasicsofthermodynamics

CourseOutcomes:

- Relate1stand2ndLawofthermodynamics
- Knowledgeof enthalpy,entropyandfree energy.
- Understandtheprinciplesofthermodynamicsasappliedequilibriumpositionsofchemicalreactions.
- Calculatethetemperaturedependenceofrateconstantsandrelatethiscalculationtoactivityand fugacity.
- Touseellinghamdiagrams forextractionofmetals

SYLLABUS

Introduction-
Basicconceptsinthermodynamics.Objectivesandlimitationsofclassicalthermodynamics.Zerothlawof thermodynamics.

FirstLawofThermodynamics-
FormsofEnergy,HeatandWork,JoulesExperiments,ConservationofEnergy,ConceptofMaximumWork,IsothermalExpansion,Reversible,AdiabaticExpansion, ConstantPressureProcesses,Constant VolumeProcesses, Enthalpy.

SecondLawofThermodynamics-
Efficiencyofcyclicprocess.Carnotcycle.Entropy.Thermodynamic equation of state.Statistical Entropy, Physical Meaning of Entropy, BoltzmanEquation,Mixing Entropy,Stirling's Approximation,

AuxiliaryFunctions.FundamentalEquationsofState,MaxwellRelationships.OtherThermodynamicRelations,ChemicalPotential,Gibbs-HelmholtzEquation,CriteriaofEquilibria.

ThirdlawofThermodynamics,HeatCapacityandEntropyChanges.SensibleHeats,Transformation Heats, Reaction Heats, ΔCp, $\Delta H=f(T)$, $\Delta S=f(T)$, Adiabatic Flame Temperatures,HeatBalances.

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

Textbooks:

1. IntroductiontoMetallurgicalThermodynamics,DavidR.Gaskell.
2. ProblemsinThermodynamics&Kinetics,G.S.Upadhyaya andR.N.Dubey.

ReferenceBooks:

1. ChemicalMetallurgy, J.J.Moore
2. PhysicalChemistry ofMetals,L.S.Darken andG.Gurry, TataMc-Graw hill.
3. MetallurgicalThermodynamics,ML KapoorPart I&II
4. MetallurgicalThermodynamics,Tupkary

MT 2102 MINERAL BENEFICIATION

Course Objectives:

- Introducestudentstotheprinciplesoforecomminution,liberationandparticlesizeanalysisand equipmentsused.
- Teachstudentsaboutvariousmethodsofconcentration/separationand equipmentsused.
- Acquaintthestudentsaboutquantifyingconcentrationprocessesandselectionofpropermineral dressing cycles for an ore/mineral.

CourseOutcomes:

- Recognitionoftheneedof themineraldressingprior toextractionofmetals.
- Describetheworkingandconstructiondetailsofvariousequipmentsusedinmineraldressing.
- Assesstheefficiencyofconcentrationprocesses.
- Selectanddescribeaparticularconcentration processsuitabletotheliberatedore.

SYLLABUS

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

Comminution: Studyofprimaryandsecondarycrushingandgrindingunitslike Jaw,Gyratory,and reduction Gyratoryand roll crushers. TheoryofBall Milloperation, Rittinger's , Kick'sandBond'slawsofcrushingand grinding.

Laboratory sizing units.Screening.Elutriation.Sedimentation.Representation of size analysisdata.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 itsapplicationin mineral dressing.

Heavy media separation and coal washing.Tabling.Jigging.Magnetic and Electro staticseparation.Elementary treatment of principles of flotation. Surface tension, surface energy, andcontactangle.Floatability,frothers,collectorsandmodifyingagents.Differentialflotation.Flotatio ncircuits.

Studyofbasicde-wateringtechniques like-sedimentation–filtration –drying..

Textbooks:

1.PrinciplesofMineralDressing,Gaudin,A.M.

References

1. MineralProcessing Technology,S.K.Jain
2. UnitoperationinChemicalEngineering.

MT2103IRON MAKING

CourseObjectives:

- Illustratetheapplicationsofthermodynamicsandkineticsinproductionofpigironandrefiningit.
- Outlinethetechniquesforproductionandprimary processinginBlast furnace.
- Differentiatebetweenpastandpresentproductionmethodsandexaminethemoderntrendsin iron production.
- Identifyconsistsandeffectforblastfurnaceirregularitiesandtheirremedialmeasures.

CourseOutcomes:

- Identify the required parameters and design of a blast furnace and illustrate ancillaryequipment and measures to be taken for starting and trouble shooting of Blast furnaceprocess.
- Predict the physico-chemical phenomena taking place in blast furnace. Able to performsimplemass balanceandcomplex problems.
- Identifyandexplainthemodernizationtechniquestoimprovequantity,qualityandminimizatio nofwaste.
- Able to predict the possible alternative processes to be followed suitable to the localconditionsin viewof energy, environmentalandefficiencyconsiderations.

SYLLABUS

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

Blast furnace and accessories: Description of modern blast furnace. Design of blast furnacestoves,Blast furnace refractories, Blastfurnacecooling system,Gas cleaningsystem.

Chargingsystem,Distributionofburdeninblastfurnace, Blastfurnaceinstruments.

Physical chemistry: Blast furnace physical structure, blast furnace reactions, Distribution ofelements in molten metal and slag. Internal and External desulphurization, Blast furnace slagpropertiesand uses.Acidand Basic burdening practices,

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

Alternate routes of pig iron production: Electric arc furnace process, Low shaft furnace, MiniBlastFurnaceprocess,Char coalfurnaceprocess.Production ofwroughtiron.

Textbooks:
1. Introductiontomoderniron making,R.H.Tupkary
2. Introductiontomoderniron making,A.K.Biswas
3. PhysicalChemistryofIron&SteelMaking,C.Bodsworth

References:
1. MSTS-UnitedSteel Corporation,Pittsburgh
2. Blastfurnacetheory&practice- Vol.I&II,JuliusJH.Strysbugen

MT2104 PHYSICALMETALLURGY

CourseObjectives:

- The prime objective of this course is to make the student gain an understanding of therelationbetweenmicrostructural characteristicsandproperties ofmetalsand alloys.
- The course alsocritically focuses on the crystallography, phase transformations thatoccurinseveralferrousandnonferrousmetallurgicalsystemsasafunctionoftemperaturean d composition through phaseequilibriumdiagrams.

CourseOutcomes:

- Explainthesolidificationofmetalsandalloys,mechanisms.
- Explainthenecessityof alloys, willidentifythedifferent typesofalloy phases.
- Explaintheconstructionandidentificationofphasediagramsand reactions.
- ExplaintheFe-Fe3Cdiagramwithinvariantreactions.
- ExplaintheCu-Znandotherbinary diagramsand complexphase diagramsetc.

SYLLABUS

Solidification: Solidificationofpuremetals,alloysandeutectic.Nucleationandgrowth,Homogenousa ndHeterogeneous,constitutionalsuper cooling,coringand segregation.

Phaserule,principlesofconstructionandinterpretationofbinaryphasediagrams.Invariantreacti ons,Free energycompositiondiagrams,usesandlimitationsofphasediagrams.

Equilibriumandnon-equlibriumphase diagrams-Fe-C,Cu-Zn,Cu-Sn, Al-Si, Al-Cu,Pb-Sn. Ternarydiagrams and interpretationofStructures on cooling.

Diffusionofmetals-Fick'slaw, mechanisms of diffusion, solutions to diffusionEquations, diffusion in alloys,Kirkendal effect, Factors affecting, diffusion, grainBoundarydiffusion, applications.

Textbooks:

1. PhysicalMetallurgy- S.H.Avner
2. PhysicalMetallurgy -V.Raghavan
3. PhysicalMetallurgy -VijendraSingh
4. Mechanical Metallurgy -G.E. Dieter

Referencebook:

1.PhysicalMetallurgy-R.E.ReedHill

MT2105MANAGERIALECONOMICS

CourseObjectives:

- TobringaboutanawarenessaboutthenatureofManagerialEconomicsanditslinkageswithother disciplines.
- TounderstandtheMicro and MacroEnvironment ofBusiness.
- TofamiliarizetheprospectiveengineerswiththeconceptsandtoolsofManagerialEconomicswi th an objectiveto understand thereal worldof business.

CourseOutcomes:

- Understandthevarious economicactivitiesin businessandindustry.

- Analysethereal worldbusiness problems.
- Make optimal business decisions for the effective and efficient management ofOrganisations.

SYLLABUS

SignificanceofEconomicsandManagerialEconomics:
Economics: DefinitionsofEconomics-
Wealth,WelfareandScarcitydefinitionsClassificationofEconomics-Micro andMicro Economics.

ManagerialEconomics: Definition,NatureandScopeofManagerialEconomics,Differencesbetween Economics and Managerial Economics, Main areas of Managerial Economics, ManagerialEconomicswith otherdisciplines.

DemandandUtilityAnalysis:

Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptionsand limitations. Exceptional demandcurve.

Elasticityofdemand -Definition,Measurementofelasticity,TypesofElasticity
(Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Roleofincome elasticityin business decisions,FactorsgoverningPriceElasticity ofdemand.

Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, TotalUtility,Marginal Utility,Thelawof Diminishing Marginal Utility andits Limitations**.**

TheoryofProductionandCostanalysis:
Production - Meaning, Production function and its assumptions, use of production function indecisionmaking;

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.Unavoidablecosts, Economies and Diseconomiesof scale.

Market Structures : Definition of Market, Classification of markets; Salient features or conditionsof different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinkeddemandcurve;Monopolistic Competition.

Pricing Analysis : Pricing – Significance; Different Pricing methods- Cost plus pricing, Targetpricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricingof joint Products, Pricing over the life cycle of a Product, Skimming pricingPenetration pricing,Mark-up and Mark-down pricing of retailers.

Business cycles - Definition, Characteristics, Phases, Causes and Consequences; Measures to solveproblemsarising from Businesscycles.

TextBooks:

1. Sankaran,S.,ManagerialEconomics,Marghan Publications,2015,Chennai.
2. Aryasri, A.R., Managerial Economics and FinancialAnalysis, MC Graw HillEducation,NewDelhi,2015.

ReferenceBooks:

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.

MT2106MATERIALS SCIENCE

CourseObjectives:

- Todescribethebasicsofcrystalstructureanditstypes
- Togain a thoroughknowledgeaboutcrystal defects
- Toimpart knowledgeabout theusesand application ofpolymers
- Explaintheusesand applicationsofvariousceramics
- Describeabouttheusesandapplicationofvariousfoams

CourseOutcomes:

Atthe endofthecourse,studentwill

- Useandapplybasicsofmaterial scienceinhisownbranchofengineering
- Appreciatetheimportanceofpolymersandtheirclassificationandapplytheknowledgeforthe practical applications
- Describethepropertiesofceramicsandchooseaparticularceramicforagivenapplication.
- Correlatethestructure,propertyandapplicationsofceramicsandpolymers.

SYLLABUS

Introduction: Classificationofmaterials**,**Spacelatticeandunitcells,

Crystalsystems Indices forplanesand directions.Structuresofcommonmetallicmaterials.

Crystaldefects: Point,Lineandsurfacedefects.Dislocations,types,Burgers'Vector.Dislocationmovement by slip, climband cross slip. Dislocation sources.

SlipsystemsforBCC,FCCandHCPmetals,Criticalresolvedshearstress(CRSS)forslip,Twinning,Stacking faults, Jogs, Kinks.

Polymers:Classification,propertiesandapplications,Molecularstructureofpolymers,Polymerization,Mechanical properties of polymers

Ceramics:Classificationpropertiesandapplications,MechanicalpropertiesofCeramics,GlassandGlass ceramics, Processing of Ceramics

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

Textbooks:

1. TextbookofPolymerScience;FredW.Billmeyer,Wiley2007
2. IntroductiontoCeramics;Kingery,Bowen,Uhlman.Wiley IndiaPvtLimited,2012
3. CompositeMaterials:ScienceandEngineering; KrishanK.Chawla,Springer,2012

MT2107MINERALBENEFICIATIONLAB

CourseObjectives:

- Thislaboratorycoursecriticallydealswiththe experimentsrelatedtooredressingprinciples
- Apartfromthis,italsoconcerns aboutlaboratory modelsofmineraldressingoperations

CourseOutcomes:

- Pickortakearepresentative amountof sampleand conduct sieveanalysis
- Determinethereductionratioincrushingandgrindingofdifferentmaterialsusingvarioussizereduction units
- Analyzethegrindabilityofdifferentcoals
- Separateorconcentratethegivenmaterialsusingfrothflotationprocesses

Listofexperiments:

1. Samplingbyconingandquarteringandrifflesampler.
2. Determinationofaverage particlesizebysieveanalysis.
3. Determinationofoptimumtimeofsieving.
4. StudiesonsizereductionusinglaboratoryJawCrusher.
5. StudiesonsizereductionusinglaboratoryRollCrusher.
6. StudiesonsizereductionusinglaboratoryBallMill.
7. Heavymediaseparations(sink andfloatexperiment)
8. LaboratoryexperimentationFrothFlotation.
9. DeterminationofGrindabilityofCoal.

MT2108 MOULDINGANDCASTINGPRACTICE

CourseObjectives:

- Tostudy mouldingredients
- Tounderstandmouldmakingproceduresforwetanddryprocesses
- Toknowthestructuralchangesandhardness
- Toknowtheproblems during meltingand castingofpuremetalsandalloys

CourseOutcomes:

- Togetmoulding skillinvarious mouldingprocesses
- ToGainknowledgeindevelopingpropermeltingandcastingproceduresofvariousalloys
- ToKnowthestructuralandpropertychangesoneffectofmouldingpracticesofimportantengineering alloys

SYLLABUS

Introductiontovariousmouldingredientsandmouldingpracticesof:

1. Wetmoudlimg-Bentonitebasedprocess
2. Drymoudling-Sodiumsilicateprocess
    a. CO_2process
    b. Ferrosiliconprocess

Meltingandcastingpracticesof:

1. Purealuminium

2. Al-Cubinaryalloys
3. Al-Cu-Mgternaryalloys

Evaluationof Castings:

1. Visualinspection
2. Microstructurestudies
3. Hardnesssurvey

MT 2109 PROFESSIONAL LAWS & ETHICS AND UNIVERSAL HUMANVALUES

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:

PremvirKapoor. *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.

MT2201HEATTREATMENT

CourseObjectives:

- Thiscourseismainlydesignedtoimpartknowledgeaboutbasicprinciplesandprocessvariables ofdifferent heat treatment processes.
- Tounderstandthetechniquesofthermomechanicaltreatment,surfacehardeningtechniques,he at treatmentof steels,cast irons,nonferrousalloys indetail.
- Togainbasicknowledgeaboutdifferenttypesofphasetransformations,coolingcurvesandeffec t ofalloying elements on cooling curves..

CourseOutcomes:

- Todemonstrateacriticalunderstandingoftheimportanceofheattreatmentinachievingfitforpur posein steels
- Toapplyandinterpretphaseandcontinuouscoolingdiagramstoassesstheimpactofarangeof heat treatment procedures
- Tochooseandjustifyaprocedureforaparticularalloyinordertoachievethepropertiesrequiredfo r aparticular 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 itsdetermination.Heat Treatment Furnaces andatmospheres.

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

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

Surfacehardening. Carburising,nitriding,cyaniding,carbonitriding.Inductionandflamehardening.

Textbooks:

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

References:

1. PhysicalMetallurgy,V.Raghavan
2. IntroductiontoPhysicalMetallurgy,S.H.Avner
3. PhysicalMetallurgyPrinciples,R.E.Reed-Hill.
4. PhysicalMetallurgyforEngineers,Clarkand Varney

MT2202 METALLURGICALTHERMODYNAMICS–II

CourseObjectives:

- Thelaws of diffusion.
- InterpretEllinghamdiagrams
- Identifymetallurgicalthermodynamicsprinciplestobeappliedinphasediagrams.

CourseOutcomes:

- UnderstandandabletouseFick's IandIIlaw.
- InterpretEllinghamDiagramforoxides
- Understandthethermalpropertiesofsolids,specifically,specificheatandsomemodelsforspecificheatcalculation.
- Knowledgeofidealand regularsolutionsandfreeenergyofmixing.
- Applythe phaseruleonthemetallurgicalsystems.
- Understanding of the natureofpolarizedelectrochemicalreactionsand anintroductionoftheirapplication incorrosion behavior ofmetals.

SYLLABUS

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

Equilibria in Gaseous Systems: The Equilibrium Constant and ΔG°, Reaction Extent Problems,Equilibriain SystemsContaining CondensedPhases, Ellingham Diagram,Activities.

Solution Thermodynamics - Thermodynamic solutions. Raoult's law.Henry's law.Sievert'slaw.Absolute and Partial and Integral Molar Quantities, Relative and Partial Integral MolarQuantities,IdealSolutions,ExcessQuantities,Gibb'sDuhemEquation,TangentInterceptMethod, a=f(T), Change in Reference State, 1 wt % Reference State Interaction Parameters.Actualsolutions.Regularsolutions.

Applicationofthelawsofthermodynamicstometallurgicalprocesses,electrochemistry,interfacialphenomena,extraction and refining of materials.

KineticsofMetallurgicalreactions.Collisiontheory.Theoryofabsolutereactionrates.

Textbooks:

1. IntroductiontoMetallurgicalThermodynamics,DavidR.Gaskell.
2. ProblemsinThermodynamics&Kinetics,G.S.Upadhyaya andR.N.Dubey.

ReferenceBooks:

1. ChemicalMetallurgy, J.J.Moore
2. PhysicalChemistry ofMetals,L.S.Darken andG.Gurry, TataMc-Graw hill.
3. MetallurgicalThermodynamics,MLKapoorPart I&II
4. MetallurgicalThermodynamics,Tupkary.

MT2203Python 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 DataFrame, 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

MT2204NONFERROUSEXTRACTIVEMETALLURGY–I

CourseObjectives:

- Toexplainthevarious methodsofextraction ofnonferrousmetals.
- To describe the procedure and equipment used for production of non ferrous metals fromtheirores.

CourseOutcomes:

- Get detailed information about the properties of non ferrous metals, ores of non ferrousmetals,pre treatmentprocesses,thermodynamicsandkineticsinvolvedinextractionprocess
- Describe and explain ore treatment techniques and learn the fundamental concepts ofmetallurgical pre-treatment methods, production of metals from ore, concentrate andsecondarysources
- Emphasizethestrategicimportanceofrawandsupplementarymaterialsintheproduction,and explaintheconcepts oftechnological and economicalfeasibility
- Identify the beneficiation of byproducts materialize during the metal production, withintheframework of technology-environment-ecology
- Explainprocessesbasedonanadvancedthermodynamicperspectiveandexplainmaterialand energy flows relatedto extraction ofmetalsand alloys
- Understand about Extractive metallurgy processes and explain their relative merits anddemerits and also Conduct a detailed and individual research about production of aspecificmetal, as part oftheirresponsibility.

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. Indianplantpractice.New processes.Alcoaprocess.

Magnesium:Uses.Ores.Pidegon'sprocess.ExtractionbyDowsprocess.

Tin: Uses.Ores.Concentration,smeltingandrefining.

Copper. Uses.Pyro-metallugicalprocesses.Newprocesses.Flashsmelting.WORCAandNorandaprocesses.Hydro-metallurgyofcopper.CopperproductioninIndia.Nickel:Briefdescriptionof Ni extraction from sulphideores.

Lead: Uses.Ores.Treatmentoforeandproductionofmetal.

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

Textbooks:

1.ExtractionofNon-FerrousMetals,HS Ray,RSridharandKP Abraham

ReferenceBooks:

1. MetallurgyofNon-FerrousMetals,Dennis,WH
2. Non-FerrousMetallurgy,Sebryukov,NMin,Pub.Moscow

MT2205MECHANICALPROPERTIESOFMATERIALS

CourseObjectives:

- Togainandunderstandingoftheresponseofvariousmetalsundertheapplicationofstressand/ortemperature.
- To buildnecessarytheoreticalbackgroundof the roleof latticedefectsingoverning bothelasticand plasticproperties of metals will be discussed.
- Obtaina workingknowledgeofvarious hardnesstesting machines BHN,VHN, RHN
- Obtainaworkingknowledgeofcreepandfatigue andanalysisofdata.

CourseOutcomes:

- Describeandcorrelatethestructureandmechanicalpropertiesof differentkindofmetals.
- Identify,formulateandsolveengineeringproblemsrelatedtomechanical behaviour.
- Toknowthebehaviourofmaterialunderdifferentloadingconditions.
- Demonstratefracture,andfatiguecontrolonstructure.
- Selectionofpropertestingmethodtoanalyzephysicalstructureandhardnessofmaterial.
- Knowledgeofhowto incorporatematerialstrengthlimitation intoengineeringdesign.

SYLLABUS

Introduction:Importanceoftesting.

Tensiontest: Engineeringstressstraincurve.Truestressandtruestraindiagram. Ductility measurements.Typical stressstrain diagrams.Yield pointphenomenon, strainageing.

CompressionTest: Fundamentalsoftesting,applications.
Hardnesstest:Introduction,Brinell,VickersandRockwellhardness,Microhardness.

Fracture: Introduction, types of fracture in metals.Brittle fracture and impact testing: Theproblems of brittle fracture. Notched bar impact tests, significance of transition temperature,metallurgicalfactors affecting transition temperature

Creep and stress rupture: The creep curve.Stress rupture test.Structural changes duringcreep, mechanisms of creep deformation, High temperature alloys, presentation of engineeringcreepdata, prediction oflong timeproperties

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

Textbooks:

1. MechanicalMetallurgy, GeorgeEDieter,McGrawHill.
2. Testingof Materials,A.V.K.Suryanarayana,PrenticeHallofIndia.

ReferenceBooks:

1. TestingofEngineering Materials,Donaldet.al.,McGraw Hills.
2. Metalshandbook

MT2206METALLOGRAPHY LAB

CourseOutcomes

- Can describe the metallurgical microscope, sample preparation, mounting anduse/choosingof differentetching reagents.
- Canidentifyandreportthemicrostructuralfeaturesofferrousandnonferroussamplesobserved.
- Canoperateopticalmicroscopewithan ease
- Characterizemicrostructuresofengineeringalloysusingopticalmicroscopy

SYLLABUS

About12experimentsontheMetallographyofcommonferrousandNon-Ferrousmetalsandalloys,experiments on thermal analysis.

MT2207Python programmingLAB

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 dataframes
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 DataFrames 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 VilhelmPersson and Luiz Felipe Martins, Mastering Python Data Analysis, Packt Publishing

Ltd

7. SebastianRaschka&VahidMirjalili, “Python Machine Learning”, Packt Publisher, 2017

MT2208WELDINGPRACTICE

CourseObjectives:

- Studyof weldingproceduresformetalsand alloys
- Studyofstructuralchangesandhardness
- Studyofproblemsduringweldingofferrousandnon-ferrous alloys

CourseOutcomes:

- Getweldingskillinjoiningvariousengineering alloys
- Gainknowledgein useof properprocedurein weldingofvarious alloys
- Knowthestructuralandpropertychangesduringweldingofimportantengineeringalloys

SYLLABUS

Welding procedure : Cleaning, Edge preparation and Selection of welding parameters

ShieldedMetalarcweldingand GasTungstenArcWelding

Weldingofmildsteel,WeldingofStainlesssteels,WeldingofAluminiumalloy,WeldingofTitanium alloy

Identificationofvariouszones Microstructuralchanges, Hardnesssurvey

TextBooks:
1.WeldingTechnology-RSParmar

ReferenceBooks:
1.Metalcastingand Joining -KCJohn

MT2209ENVIRONMENTALSCIENCE

CourseObjectives:

- Familiarizethefundamentalaspectsofenvironmentandtheenvironmentalmanagement'
- Provideinformationofsomeoftheimportantinternationalconventionswhichwillbeusefulduri ng thefutureendeavors aftergraduation.
- Makerealizetheimportanceofnaturalresourcesmanagementforthesustenanceofthelifeand the society.
- Apprisetheimpactofpollutiongettinggeneratedthroughtheanthropogenicactivitiesontheenvi ronment
- ProvidetheconceptofSustainableDevelopment, energyandenvironmentalmanagement
- Impartknowledgeonthe new generationwaste likee-waste andplasticwaste.

CourseOutcomes:

- Knowledgeonthefundamentalaspectsofenvironmentandtheenvironmentalmanagement
- Theknowledgeonthe salientfeaturesoftheimportantinternationalconventions
- Understandingoftheimportanceofnaturalresourcesmanagementforthesustenanceofthelifea nd the society.
- Familiarityonvariousforms ofpollution andits impactontheenvironment.

- UnderstandtheelementsofSustainableDevelopment,energyandenvironmentalmanagement
- Knowledgeonthe newgenerationwaste likee-wasteand plasticwaste.

SYLLABUS

Introduction: StructureandfunctionsofEcosystems-EcosystemsanditsDynamics-ValueofBiodiversity-impactoflossofbiodiversity,Conservationofbio-diversity.Environmentalindicators
- Globalenvironmentalissuesandtheirimpactontheecosystems.
Salient features of International conventions on Environment: Montreal Protocol, Kyoto protocol,Ramsar Convention on Wetlands, Stockholm Convention on Persistent Organic Pollutants, UnitedNationsFramework Convention on ClimateChange(UNFCCC),

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

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

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

Mineral Resources: Impact of mining on the environment and possible environmental managementoptionsin mining and processing ofthe minerals.
Sustainable resource management (land, water, and energy), and resilient design under the changingenvironment.

EnvironmentalPollution: LocalandGlobalIssues.Causes,effectsandcontrolmeasures.Engineeringaspects 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 itsimpacton environment.Marinepollution and itsimpact on blueeconomy.Noisepollution.

Solidwastemanagement: Importantelementsinsolidwastemanagement-Wastetoenergyconcepts. Air (prevention and control of pollution) Act, Water (prevention and control of pollution)Actand their amendments.Salient features of Environmental protection Act,1986.

Sustainable Development: Fundamentals of Sustainable Development–Sustainability Strategiesand Barriers – Industrialization and sustainable development. Circular economy concepts in waste(solidand fluid) management.

EnergyandEnvironment: EnvironmentalBenefitsandchallenges,Availabilityandneedofconventional energy resources, major environmental problems related to the conventional energyresources, future possibilities of energy need and availability. Solar Energy: process of photovoltaicenergy conversion, solar energy conversion technologies and devices, their principles, working andapplications, disposal of solar panel after their usage. Biomass energy: Concept of biomass energyutilization,typesofbiomassenergy,conversionprocesses,WindEnergy,energyconversiontechnologies,their principles, equipment and suitability in contextofIndia.

Management of plastic waste and E-waste: Sources, generation and characteristics of various e- and plastic wastes generated from various industrial and commercial activities; Waste managementpracticesincludingonsitehandling,storage,collectionandtransfer.E-wasteandplasticwaste

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

TextBooks:

1. Bharucha,Erach(2004).TextbookforEnvironmentalStudiesforUndergraduateCoursesofallBranches of Higher Education, UniversityGrants Commission, NewDelhi.
2. Basu,M.,Xavier,S.(2016).FundamentalsofEnvironmentalStudies,CambridgeUniversityPress,India
3. Masters,G.M.,&Ela,W.P.(1991).Introductiontoenvironmentalengineeringandscience.EnglewoodCliffs, NJ: PrenticeHall.
4. Enger,E.andSmith,B.,EnvironmentalScience:AStudyofInterrelationships,Publisher:McGraw-HillHigher Education; 12th edition, 2010.

ReferenceBooks:

1. Sharma,P.D.,&Sharma,P.D.(2005).Ecologyandenvironment.RastogiPublications
2. Agarwal,K.C.2001 EnvironmentalBiology, NidiPubl. Ltd.Bikaner.
3. ClarkR.S.(2001).MarinePollution,ClandersonPressOxford (TB)
4. Jadhav,H&Bhosale,V.M.(1995).EnvironmentalProtectionandLaws.HimalayaPub.House,Delhi 284 p.
5. MoEF&CC,Govt.ofIndia,CPCB:E-wastemanagementrules,2016anditsamendments2018.
6. MoEF&CC,Govt.ofIndia,CPCB:Plasticwastemanagementrules,2016.

SYLLABUS -III/IVFirstsemester

MT3101FOUNDRYTECHNOLOGY

CourseObjectives:

- Tostudythescience andengineeringof casting.
- Tostudythevariousmoulding materials and techniques
- To study various types of patterns and materials

CourseOutcomes:

Aftercompletingthiscoursethestudenthave:

- Knowledgeoftechnicalprocedures ofmakingpatterns and moulds
- Theabilitytodesign gating system for the castings

SYLLABUS

Introduction: Statusoffoundryindustryandcomparisonwithothermanufacturingprocesses.Typesof foundries.Basic operations.

Patterns.Patternmaking.Materials for pattern making. Types of patterns .Pattern allowance. Coreboxes.

Moulding materials.Properties.Preparation and testing.Moulding processes. Sandmounding.**Moulding techniques**.Hand and machine compaction.Machine moulding.Cores and core making.Sodiumsilicate processes.Shell, InvestmentandDie-casting.Centrifugalcasting.

Solidification–Crystallizationanddevelopmentofcaststructure.Directionalsolidification.Principlesof gating andrisering.Modernization andmechanization offoundries.

TextBooks:

1. PrinciplesofMetalCasting,Heine,LoperandRosenthal,TataMcGraw Hill
2. Principles of FoundryTechnology,P.L.Jain,TataMcGraw Hill

ReferenceBooks:

1. FoundryTechnology, PRBeeely,London-Buterworths

MT3102ADVANCESINIRONMAKING

CourseObjectives:

- Thiscourseintroducestheprinciplesof spongeironmaking
- To know the various smelting reduction processes

CourseOutcomes:

- Describethephysicaland chemical processes thattakeplace duringsponge ironmaking
- To familirize with recent developmentsinironmaking
- Describevarious methods of smelting and reduction

SYLLABUS

SpongeIronmaking: Principlesandclassificationofspongeironprocesses,Coalbasedprocesses:Rotar y kiln process; Rotary hearth furnace process (Fastmet process, ITmk3 process); Gas basedprocesses–Finmetprocess,Midrexprocess,HYLprocesses(HYL-III&HYL–IVMprocesses).

Smelting Reduction (SR): Fundamental of SR, Classification and important SR processes: Mini BlastFurnaceprocess,COREXprocess,Finexprocess,Fastmeltprocess,Hismeltprocess,Romeltprocess.

Textbooks:

1. Ironmaking&SteelMaking-TheoryandPractice-AhindraGhosh,AmitChattterjee
2. SpongeIronProductionbyDirectreductionofIronOxide–AmitChatterjee

ReferanceBooks:

1. HotmetalproductionbySmeltingReductionofIronOxide–AmitChatterjee

MT3103NONFERROUSEXTRACTIVEMETALLURGY -II

CourseObjectives:

- To know the extraction procedures of gold, silver and various nuclear metals
- To know the basics of nuclear reactor technology

CourseOutcomes:

- Able to understand the extraction procedures used for Gold and Silver

- Able to know the procedures and principles of extracting various nuclear metals
- Able to know the working of Nuclear reactors and its technology
- To know the production practice of nuclear metals in India

SYLLABUS

Productionflowsheetsofextraction ofGoldandSilver.

Uranium.Extraction of Uranium.Production flow sheet of Jaduguda

ore.Productionflowsheets of extraction ofThorium.

BriefoutlinesofextractionofPlutonium.

Titanium.Production of Titanium chloride from Ilmenite.Production of Ti

sponge.Zirconiumproduction in India.

NuclearReactorTechnology.Fuelfornuclearreactors.Basiccomponentsofareactorcharacteristicsandrequirements. Types of reactors.

Textbooks:
1.ExtractionofNon-FerrousMetals,HSRay,RSridharandKPAbraham

References:
1. MetallurgyofNon-FerrousMetals,Dennis,WH
2. Non-FerrousMetallurgy,Sebryukov,NMin,Pub.Moscow

MT3106HEATTREATMENTLAB

CourseObjectives:

- Conductheattreatmentinfurnacesundersuitable/requiredtime,temperatureandatmosphericconditions.
- Modify the microstructures of metals and alloys through heat treatment practice for obtainingdesiredproperties in present and future.

CourseOutcomes:

- Tomodifythebulk and surfacepropertiesofsteels.
- TodeterminehardenabilitybyperformingJominyendquenchtest
- Analyze,correlateandinterprettheresults obtainedinthetestsconducted.
- Reporttheobservationsinaproper format.

SYLLABUS

ListofExperiments:

1. Annealing,Normalizing,hardeningandtemperingofsteels.
2. Recoveryandrecrystallizationofcoldworkedmetal.
3. Effectofquenchingmediaon hardening
4. Studyofweldedstructures.
5. JomneyEnd QuenchTest.
6. Packcarburizingoflow carbonsteels.
7. Agehardening of aluminum alloys
8. Effectof timeand temperatureon tempering

TextBooks:

1. HeatTreatmentofMetals -Zakharov
2. HeatTreatment Principle andTechniques-Rajan&Sharma

ReferenceBooks:

1. PhysicalMetallurgy–Lakhtin
2. PhysicalMetallurgy-ClarkandVarney
3. PhysicalMetallurgyPrinciples-ReedHill
4. PhysicalMetallurgy–Raghavan

MT3107METALCASTINGLAB

CourseObjectives:

- Introduceandexplainvariousproperties of moulding sand
- To know the procedure of testing moulding sand

CourseOutcomes:

- Havefundamentalknowledgeof properties of moulding sand
- Understandtest procedures of mould sand properties
- Havebasicknowledgeof ranges of moulding sand properties
- Evaluate suitability of various sands for moulding purpose
- Learnmorebypracticalknowledgeanddeveloptheirscientificandtechnicalcompetencesinthefield of foundry.

ListofExperiments

Varioussandtestswillbecarryouttoevaluatethemouldproperties.Thetestsareincludedlike:

1. Claycontent
2. AFSgrainsizemeasurement
3. Permeabilitytest
4. GreenCompression

5. GreenShear
6. DryCompression
7. Dryshear
8. Toughness
9. Hardness
10. ShatterIndex

TextBooks:

1. Heine,LoperandRosenthal,"PrinciplesofMetalCasting",TataMcGrawHillPublishingCo,Ltd; New Delhi, 1995.
2. FoundryTechnology -DevendraKumar andS.K.Jain
3. MetalsHandbook Vol.5published byASM, Ohio.
4. FoundryTechnology-Jain.
5. FoundryTechnologyPrinciple-RamanaRao.

MT3108FOUNDRYPRACTICE

CourseObjectives:

- Broadknowledgeaboutdifferenttypesofmelting and casting practices
- To know the foundry practice of various cast irons
- Understandissues related to melting practices of non-ferrous metals and alloys.

CourseOutcomes:

- To know the melting procedures of non-ferrous metals and alloys
- Understandingfoundry practice of various types of cast irons
- Ableto know the reasons for the defects in castings
- Abletoknow the procedure of quality control of castings

SYLLABUS

Generalprinciplesofmeltingandcastingpractices
Various melting furnaces and its operation: Cupola, Induction furnace and Electric Arc furnace.Meltingpracticeof non-ferrous materials: Al, Cuand Mg alloys.
Foundry practices of white, gray, SG and malleable irons.Alloy cast irons.Steelfoundry practice.
Defectsincastings.
Fettling.
Inspectionandqualitycontrol.
Modernizationandmechanizationoffoundries

Textbooks:

1. PrinciplesofMetalCasting,Heine,LoperandRosenthal,TataMcGrawhill
2. FoundryTechnology,PCJain,TataMcGrawhill
3. FoundryTechnology,PRBeeely,London-Buterworths.

ReferenceBooks:

1. Heine,LoperandRosenthal,"PrinciplesofMetalCasting",TataMcGrawHillPublishingCo,Ltd; New Delhi, 1995.

2. FoundryTechnology -DevendraKumar andS.K.Jain
3. MetalsHandbook Vol.5published byASM, Ohio.
4. FoundryTechnology-Jain.
5. FoundryTechnologyPrinciple-RamanRao.

SYLLABUS-III/IVSecond semester

MT3201 METALFORMING

CourseObjectives:

- ToKnowthemechanicalandmetallurgicalfundamentalsformetalformingprocesses.
- ToKnowtheprocessesparameters,formingloads,processdesignandtooldesignindifferentpro cesses.
- ToAnalyzethe behavior ofmetals duringplasticdeformation.

CourseOutcomes:

- Compareandclassifydifferentformingprocesses.
- Analyzethebehaviourofmaterialsduringformingprocesses.
- Determineformingprocessescontrollingparameters.
- Estimaterequiredformingloads,powersofdifferentformingequipmentandprocesses.
- Determinethecauseofthedefectsthatmaytakeplaceduringformingprocesses.
- Integrateknowledgegainedinthiscoursetoselectanddesignacompletemetalformingsystem.

SYLLABUS

Fundamentals of metal working. Classification of forming processes, Temperature in metal working,Strain-rateeffects,MetallurgicalStructure,FrictionandLubrication.

Forging:Classification,Forgingequipment,Opendieandcloseddieforging,Calculationofforgingloadsincl oseddieforgingandForgingdefects.

Rollingclassification.Rollingmillsandaccessories.Hotandcoldrolling.Forcesandgeometricrelationships inrolling.Rollingvariables.Problemsanddefectsinrolledproducts.

Extrusion:Classification,Extrusionequipment,Hotextrusion,lubricationanddefectsinextrusion.Extrusio noftubing.

Drawingofrodswiresandtubes.Sheetmetalforming.

TextBooks:

1. MechanicalMetallurgybyG.E.DieterMcGrawHillBookCo.,
2. IntroductiontoPhysicalMetallurgybyS.H.Anver,McGrawHill

ReferenceBooks:

1. Mechanicalworkingofmetals-Avitzone.
2. EngineeringMetallurgy–Part-II–Higgins

MT3202ENVIRONMENTALDEGRADATIONOFMATERIALS

CourseObjectives:

- ToKnowthe electrochemical and thermodynamicaspects ofcorrosion.
- ToKnowthe various forms ofcorrosion.
- Toknow the preventive methods of corrosion

CourseOutcomes:

- Explaintheimportanceofstudyingcorrosion
- Describethethermodynamicaspectsofcorrosion
- Describethekineticaspectsofcorrosion
- Indicatethevariousformsofcorrosion
- Explainthemeasurementandcontrolofcorrosion.

SYLLABUS

Corrosion–
ElectrochemicalaspectsofCorrosion.Corrosioncells/Electrochemicalcells,DeterminationofElectrodepotential.Thermodynamicaspects-
Nerrnestequation,.Galvanicseries.Polarization,Linearpolarizationtechniqueforevaluationof Icorr.Pourbaixdiagrams

Types and Forms of Corrosion.Uniform Corrosion, Pitting Corrosion, Galvanic Corrosion, andIntegranularCorrosion.StressCorrosioncracking,CavitationErosion,ErosionCorrosion.CorrosionFatigue..

PreventionMethods: Coatings,MetallicandNonMetallic,Designrules,ControlofEnvironment,AnodicandCathodicProtectionTechniques.

Textbooks:

1. AnintroductiontoElectrometallurgy,SharanandNarain,StandardPublishers
2. CorrosionEngineering,MGFountana,Mc-GrawHillBookCompany

MT 3203 ADVANCES IN STEEL MAKING &PRODUCTION OF FERROALLOYS

CourseObjectives:

- Togainathoroughknowledgeaboutthermodynamicsandphaserelationsintheproductionofiron and ferroalloys.
- To understandthe productionmethodologyfor aparticular type ofiron/ferroalloyfromgivenore,otherraw materials and set of conditions.

CourseOutcomes:

- Tounderstandthefundamentalsincludingthermodynamicsandphaserelationsintheproductionofiron and ferroalloys.
- To perform basic calculations like mass and energy balance relating to production of iron andferroalloys,taking into considerationthe thermodynamiclimitationsand kinetics.

- To know details about several aspects involved in ferrous metallurgy like procuring rawmaterials and its preparation, furnaces and its accessories, blast furnace irregularities andprocesscontrol,alternateroutes of iron making.
- Toidentifyandchooseaproductionmethodologyforaparticulartypeofiron/ferroalloyfromgiven ore, other raw materials and set ofconditions.

SYLLABUS

HybridSteelmakingprocesses,SIPandEOFprocess.

Continuoussteelmakingprocesses:WOCRA,IRSID,Spraysteelmaking,Recenttrendsinsteelmakin gprocesses.

Secondary steel making processes: Stirring Treatments, Synthetic slag refining, Injection metallurgy,Plunging Techniques, Post solidification treatments, vacuum treatments, decarburization techniques,secondaryrefiningfurnaces(LFfurnace).

Gasesinsteel,vacuumtreatmentofliquidsteel

ProductionofFerroalloys: Fe-Si,Fe-Mn,Fe-Cr,Fe-V,Silico-Manganese.

Textbooks:

1.SteelMaking,R.H.Tupkary
2.SteelMaking,Kudrin
3.SteelMaking,A.K Biswas

ReferenceBooks:

1. Themaking,shapingandtreatingofsteel-USS.

MT3206ELECTROMETALLURGYLAB

Courseobjectives:

- Electrometallurgy principles in metal deposition and winning are to beverified practically.
- To know the procedures of plating and anodizing.

CourseOutcomes:

- Able to know the practical relevance of faradays laws
- Able to know the requirements and procedures of electro plating of metals
- Able to know the procedure of anodizing

LISTOFEXPERIMENTS:

1. ExperimentalverificationofFaraday'slaws.
2. Determinationofthrowingpowerofelectrolytes.

3. Electroplatingofcopper.
4. ElectroplatingofNickel.
5. Anodizingof Aluminium.

MT3207MATERIALSPROCESSINGLAB

CourseObjectives:

- Knowtheprocedure of alloy making
- Knowthe fabrication methods of composites
- Know the basics of hot and cold working

CourseOutcomes:

- Able to make an alloy of required composition
- Able to manufacture various types of composites
- Able to know the application of cold and hot working processes

ListOf Experiments

1. Alloypreparation
2. Compositespreparation
    a. Metalmatrixcomposites
    b. Polymermatrixcomposites
    c. CharacterizationofpreparedMMCsandPMCs
3. Coldworkingstudies
4. Hotworkingstudies

MT3208NDTLAB

CourseObjectives:

- ToknowthedifferencebetweenDestructive andNon-DestructiveTastings
- ToUnderstandthebasic working principlesofNon-Destructivetesting
- Toidentifyvarioustypesof DefectsthatOccur inthematerials

CourseOutcomes:

- Provideknowledgeandexperience toobservevariousmaterialdefectsthroughNDT.

Non-destructiveevaluationwillbecarriedoutbyfollowing Experiments

1. VisualInspection
2. Diepenetrationtesting
3. Magneticparticletesting
4. Ultrasonictesting
5. Radiographytesting

MT3209SOFT SKILLS

CourseObjectives:

- Todevelopskillstocommunicateclearly.
- Toaidstudentsinbuildinginterpersonalskills.
- Toenhanceteambuilding andtimemanagementskills.
- Toinculcateactivelisteningandrespondingskills.

CourseOutcomes:

- Makeuseoftechniquesforself-awarenessandself-development.
- Applytheconceptualunderstandingofcommunicationintoeverydaypractice.
- Understandthe importanceof teamwork andgroup discussions skills.
- Developtimemanagementandstressmanagement.

SYLLABUS

Introduction to Soft Skills: Communication – Verbal and Non Verbal Communication - Personalgrooming (Etiquette, Attitude, Body Language), Posture, Gestures, Facial Expressions, Eye Contact,SpaceDistancing,PresentationSkills,PublicSpeaking,Just aMinute(JAM) sessions,Adaptability.

Goal Setting and Time Management: Immediate, Short term, Long term, Smart Goals, StrategiestoAchievegoals,TypesofTime,IdentifyingTimeWasters,TimeManagementSkills,StressBusters.

Leadership and Team Management: Qualities of a Good Leader, Team Dynamics, LeadershipStyles,Decision Making, Problem Solving, Negotiation Skills.

Group Discussions: Purpose (Intellectual ability, Creativity, Approach to a problem, Tolerance),GroupBehaviour, Analysing Performance.

Job Interviews: Identifying job openings, Covering Letter and CVs / Resumes, Interview (Opening,Body-AnswerQ, Close-Ask Q), Telephone Interviews, Types of Questions.

TextBooks:

1. Hasson,Gill.*BrilliantCommunicationSkills.*GreatBritain:PearsonEducation,2012

ReferenceBooks:

1. Krannich, Caryl, and Krannich, Ronald L. *Nail the Resume! Great Tips for CreatingDynamiteResumes*. United States,Impact Publications, 2005.
2. Prasad, H. M. *How to Prepare for Group Discussion and Interview*. New Delhi: TataMcGraw-HillEducation,2001.
3. Pease,Allan.*BodyLanguage*.Delhi:SudhaPublications,1998.
4. Rizvi, Ashraf M. *Effective Technical Communication*: India, McGraw-Hill Education.2010
5. Thorpe, Edgar &Showick Thorpe. *Winning at Interviews*. 2nd Edition. Delhi: DorlingKindersley,2006.

SYLLABUS -IV/IVFirstsemester

MT4107ADVANCEDMATERIALSPROCESSING

CourseObjectives:

- Tounderstandthebasic concepts of nano structures
- Toprovideandtrainthestudentsaboutnanomaterialsynthesisandthinfilmdepositiontechniques .
- TounderstandvariousNanostructurecharacterizationtechniques.

CourseOutcomes:

- Identifyandunderstandvarioustop-downandbottom-upapproachesfornanomaterial synthesis.
- To know the procedure of high energy ball milling for making nano powders
- To give evidence for the nano materials by characterization techniques

SYLLABUS

Introductiontonanotechnology

Discussion on various techniques of synthesis of nano materialsSynthesis of nano materials by High energy ball milling methodCharacterizationofnanopowders

i. Crystallitesize
ii. Straincalculations
iii. XRDstudies
iv. SEMstudies

Nano Composites preparation by Mechanical alloying methodCharacterizationofprepared nanocomposites

Descriptiononapplicationsofnanomaterials

TextBooks:

1.NanostructuresandNanomaterials:Synthesis,propertiesandapplicationsGuozhongCao– ImperialCollegePress.

Referencebooks:

1. MauroSardela,PracticalMaterialsCharacterization,Springer,2014.
2. RichardLeach,FundamentalPrinciplesofEngineeringNanometrology,Elsevier,2014

SYLLABUSOFPROFESSIONALELECTIVES

1. STEELMAKING

CourseObjectives:

- Thiscourseintroducestheprinciplesofsteel making
- To know the various types of steel making
- To kow the recent advances in steel making

CourseOutcomes:

- Describethephysicalandchemicalprocessesthattakeplaceduringsteelmaking
- Analysetheeffecttochangeinprocessparametersinsteelmakingprocesses
- Describethemethodsfor casting of steel

SYLLABUS

HistoryofSteelMaking:Cementationandcrucibleprocesses.

Principles Steel Making: Chemistry of Steel Making processes, Theories of slag.Oxidation of Si,Mn and C. Desulphurization, Dephosphorization and deoxidation. Mixers, Raw materials for steelmaking

PneumaticSteelMakingProcess: AcidandbasicBessemerprocess,Side blownconverter.

Open Hearth Process: Operation and chemistry of the process. Developments in OHP: AJAX,TANDEM,Tilting and twin hearth process.

BOFProcess:LD, LD-AC,LAM process,OG process,Kaldo, RotorandOBM.

ElectricFurnaceProcess: Variouselectricprocesses,theiradvantagesandlimitations.EAFconstruction,lining and operation.Discussion on manufactureofstainless steel.

Casting: Pit side process and teeming methods. Ingot moulds. Solidification of steel.Ingot defectsandremedies.Continuouscasting ofsteel.

Textbooks:

1. SteelMaking,R.H.Tupkary
2. SteelMaking,Kudrin
3. SteelMaking,Biswas

References:

1. Themaking, shaping and treating ofsteel-USS.

2. COMPOSITEMATERIALS

CourseObjectives:

- Toobtainknowledgeonclassification,processing,characterizationandapplicationsofcomposite materials.
- Toobtainknowledgeonmechanicalpropertiesandfailuremechanismsofcompositesunderloadingconditionsforengineering applications.

CourseOutcomes:

- Knowledgeonclassification,processing,characterizationandapplicationsofvariouscompositematerials
- Abilityto select proper method of fabrication for the given type of composite material

SYLLABUS

Introduction: Definition, classification, properties, applications, advantages and limitations ofcomposites,Types of matrix and reinforcements, and their properties. Mechanics of Composites,IsostrainandIso stressconditions, Role offibers,Critical fiber length.

FabricationofPolymerMatrixComposites(PMCs): Properties,ApplicationsandLimitationsofPMCs;Variousfabricationsmethods-
HandLayuptechnique,SprayUpTechnique,Filamentwelding,Pultrusion,Autoclavebasedmethods,Injectionmoulding,Extrusion.

FabricationofMetalMatrixComposites(MMCs): Properties,ApplicationsofMMCs;Fabrications methods: Liquid methods- Duralcan process, Spray forming, Squeeze casting, Stircasting;Solid state process-Diffusion bonding.

Fabrication of Ceramic Matrix Composites (CMCs): Properties, Applications and limitationsof
CMCs;Variousfabricationsmethods:Coldpressingandsintering,Hotpressing,Liquidinfiltration,Lanxide process.

Fabrication of Carbon-Carbon Composites (CCCs): Properties, Applications and limitationsofCCCs; Processing ofCCC-Solid, Liquidand Gas phasepyrolysis processes.

Textbooks:

1. MaterialsScienceandEngineering:An Introduction -WilliamDCallisterJr
2. CompositeMaterials-KrishmaKChawla.

Referencebooks:

1. ASMHandbook Volume21:Composites.

3. STRENGTHENINGMECHANISMS

CourseObjectives:

- Toexplainanddescribevariousstrengtheningmechanismsinvolvedinthedevelopmentofexisting alloys and new alloys.

CourseOutcomes:

- Explaintheprocessofstrengtheningbygrain/grainboundaryin materials.
- Explainandillustrate howalloying canimprovestrength inmetals
- Choosecoldworkingandannealingcyclesforimprovingstrengthandductilityinmaterialsforsuitableapplications.

- Compareandcontrastthedifferentmeansofstrengtheningbysmallsecondphaseparticles.
- Distinguishcompositestrengtheningbyvariousmethodsoforientationoffibersinmaterials.
- Chooseaparticularstrengtheningmechanismsfordesignofhighstrengthmetalsandalloys.

SYLLABUS

Strengthening from grain boundaries, Hall-Petch relation, ASTM grain size measurement, yield-pointphenomenon, strain aging.

Solid solution strengthening: Elastic interaction, modulus interaction, stacking fault interaction,electricalinteraction, short rangeorder interaction,long rangeorder interaction.

Coldworking:Strainhardeningof singlecrystals,annealingofcoldworkedmetal,recovery,recrystallizationand grain growth.

Strengthening from fine particles: Principle, mechanisms and examples of Precipitation hardening(age hardening), Dispersion hardening. Fiber strengthening, strength and moduli of composites (Iso-strainandIso-stress condition),influenceof fiberlength, orientation andconcentration

Strengthening by phase transformations: Annealing, Normalizing and Hardening. Martensitestrengthening.

TextBooks:

1. MechanicalMetallurgy- GeorgeE Dieter
2. MaterialsScienceandEngineeringanIntroduction -WilliamDCallisterJr
3. MaterialsScienceandEngineering –VRaghavan

ReferenceBooks:

1. MechanicalBehaviour ofMaterials -ThomasH Courtany

4.ENGINEERINGMATERIALS

CourseObjectives:

- Tounderstandtheimportanceofvariousmaterialsusedinengineeringandobtainaqualitativean alysis of their behaviorand applications

CourseOutcomes:

- Understandsvarious typesof steels theirproperties invarious conditions.
- Understandsvarious typesof castirons andtheirproperties invarious applications.
- UnderstandsvarioustypesoflightalloyslikeAl,Mg,Ti,BeandCualloysaswellastheirpropertie sand applications.

SYLLABUS

CarbonSteels: Low,mediumandhighcarbonsteels, HSLA,DualPhasesteels.

AlloySteels: Highstrengthstructuralsteels,Toolsteels,Stainlesssteels,HighTemperaturealloys.

Castirons: Whitecastiron,MalleableCastiron, GreyCastiron,Ductile Castiron.

Light alloys: Al, Mg, Ti, Be and its

alloys.Copperand its alloys.

TextBooks:

1. IntroductiontoPhysicalMetallurgy -SHAvner.
2. PhysicalMetallurgyPrinciplesandPractice –Raghavan.V

ReferenceBooks:

1.MaterialsScienceandEngineeringanIntroduction-WilliamDCallisterJr

5.NANOMATERIALS

CourseObjectives:

- Torecognizethedifferencesbetweennanomaterialsandconventionalmaterialsandtobecomefamiliarwithawiderangeofnanomaterials,theirsynthesis,characterization,propertiesandapplications.

CourseOutcomes:

- Indicatethedifferencesbetweennanomaterials andconventionalmaterials.
- Indicatehowspecificsynthesistechniquescanresultinnanomaterials.
- Give examples of specific nanomaterial and explain the scientific reasons for thePropertiesdisplayed by them.

SYLLABUS

IntroductiontoNanoTechnology: ImportanceofNano–Technology,EmergenceofNano–Technology,Bottom-Up and Top–downapproaches, challenges inNano–Technology.

Zero-dimensional Nanoparticlesthroughhomogeneousnucleation: Growth of nucleii,synthesisofmetallicnano particles, Nano particlesthroughheterogeneous nucleation:

One-dimensionalNanowiresandrods,Spontaneousgrowth: EvaporationandCondensationgrowth,vapor-liquid-solid growth

TwoDimensionalNano-structures: PhysicalVapourDeposition(PVD,ChemicalVapourDeposition(CVD),AtomicLayer Deposition (ALD).Applicationsof Nanomaterials.

TextBooks:

1.Nanostructures andNanomaterials:Synthesis,propertiesandapplications

ReferenceBooks:

1.GuozhongCao–ImperialCollegePres

6.FUNCTIONALMATERIALS

CourseObjectives:

- To introduce the studentto functional materialsand the science behind the performance ofthe functional material. To enable the student to understand the applications of functionalmaterials.

CourseOutcomes:

- Indicatethevarioustype offunctionalmaterials
- Explaintheprincipleofoperationofthefunctionalmaterial
- Indicatethe applicationsofthefunctionalmaterials

SYLLABUS

Characteristicsandtypesoffunctionalmaterials.CrystalstructureandProperties.Effectofsizeonproperties,effect of interfaces on properties

Bandstructure,Semiconductordevices: Theory,examplesandapplicationsofOpticallyactivematerials

Dielectrics:piezo-and ferroelectricmaterials:

Magneticmaterials:storageapplications,Smartmaterials

Applicationsinelectronic,communication,aerospace, automotive,energyindustries

TextBooks :

1. FunctionalMaterials:Electrical,Dielectric,Electromagnetic,OpticalandMagneticapplications;DeborahDL Chung, World ScientificPublishing, 2010

ReferenceBooks:

1. MaterialsScience–Raghavan.V
2. MaterialsScienceandEngineeringan Introduction-WilliamDCallisterJr

7.ENERGY MATERIALS

CourseObjectives:

- To learn the operating principle of several environmentally friendly energy technologies. Toidentify the material issues relevant to these technologies and to evaluate various operationalaspectsassociated with thesetechnologies.

CourseOutcomes:

- Evaluateanenergytechnologyforenvironmentalfriendliness.
- Explaintheoperatingprincipleofseveralenergytechnologies.
- Indicatethematerialrequirementsfortheseenergy technologies.
- Demonstratetheabilitytounderstandthecharacterization,performance,andfailuredatarelatedto thesetechnologies.

SYLLABUS

Energyrequirementsina globalscaleandintheIndiancontext.

Evaluationofenergysourcesfromtheperspective ofcleanenergy.Carbon equivalent

Introduction to different types of energy storage and conversion devices and technologies. Synthesisand characterization of materials used for these technologies, Properties desired in the materials,Techniques to evaluate the properties and performance, failure modes and analysis, environmentalimpactof thefollowing technologies:

I. Fuelcells
II. Batteries
III. Supercapacitors
IV. Solarenergyconversiondevices
V. WindEnergy
VI. MechanicalEnergystorage

TextBooks:

1.RenewableEnergy:PowerforaSustainableFuture,GodfreyBoyle,OxfordUniversityPress,2004.

ReferanceBooks:

1. BioMaterialScienceBuddyD.Ratneer
2. MaterialsScienceandEngineeringan Introduction-WilliamDCallisterJr

8.BIOMATERIALS

CourseObjectives:

- Tointroducethestudenttotherangeofbiomaterialsandthescienceandengineeringofbiomaterials.To understand constraintsassociatedwith theuseof biomaterials.

CourseOutcomes:

- ExplainthetypesofBiomaterialsandtheir relativeadvantagesand disadvantages.
- Indicatethe constraintsplaced ontheuseofmaterialsinbiologicalenvironments.
- Explainthecharacterizationofmaterialsfromtheperspectiveofapplicationasabiomaterial.

SYLLABUS

Typesofbiomaterials,Biological environment

Mechanical and physico-chemical properties of biomaterialsResorbability,biodegradation,Biologicalresponses,compatibility,cytotoxicity,cellbio-materialinteractions,associatedcharacterizationMetals,Polymers,Ceramics,NaturalbiomaterialsBlends ,composites, biopolymers ,HydrogelsDrugdeliverysystems

Referencebooks:

1.IntroductiontoBiomaterials:BasicTheorywithEngineeringApplications;C.LAgrawal, J.L.Ong,Mark RAppleford, GopinathMani, CanbridgeUniversity Press,2013

9.ELECTRONICMATERIALS

CourseObjectives:

- To become familiar with the science, synthesis, evaluation, and applications of electronicmaterials. To know the manufacturing processes associated with use of electronic materialsfordevices.

CourseOutcomes:

- Indicateand explainimportantscientificparametersassociatedwithelectronicmaterials.
- Describedifferentsemiconductorsandtheirpropertieswithexamples.
- Explainthefeaturesandfunctioningofseveralelectronicdevices.
- Describethemanufacturingprocessesassociated withelectronicmaterialsanddevices.

SYLLABUS

Intrinsic semiconductors. Electron and hole (carrier)

concentrations.Fermienergy level,effect oftemperatureonFermi

energy.

Carriermobility.Directvs.indirectbandgapmaterials.

Elementalvs.compoundsemiconductors.Extrinsicsemiconductors.Doping–pandntypesemiconductors

CarrierconcentrationandFermilevelasafunctionoftemperature.Driftmobility.Lightandheavydoping

Semiconductordiodesp-njunctionsatequilibrium.Forwardandreversebias.I-Vcharacteristics.Banddiagram. Diode breakdown mechanisms

LEDsandsolarcellmaterials.Transistors–MOSFETs.Banddiagramandchannelformation.Thresholdvoltage.I-V characteristics

Introductiontosemiconductormanufacturing–history,processflow,manufacturinggoals.BulkSicrystalgrowth

Overviewofmanufacturingtechnology–oxidation,photolithography,etching,doping,deposition,planarization.Cleanroom classifications

CMOS manufacturing steps.Process monitoring – blank and patterned thin film measurement.Defect inspection. Electrical testing. Yield monitoring & statistical process control. Definitions ofyield,process control, defectdensity. Process integration.Assembly and packaging.

Textbooks:

1.SemiconductorMaterials,Devicesand Fabrication,ParasuramanSwaminathan,Wiley2017

Referencebooks:

1. PrinciplesofElectronicMaterialsandDevices,S.O.Kasap,McGrawHillEducation,2017

10.FATIGUEANDFRACTUREMECHANICS

CourseObjectives:

- Tostudythedifferenttypesoffatiguefailuresandtheirmechanismsintheengineeringapplications.
- Tostudythebasictheoryoffracturemechanicsanditsrelationshipwithfatigueandcreepfailuremechanisms.
- Tounderstand thedamagetoleranceapproach inthelifeestimation ofstructures.

CourseOutcomes:

- Theabilityidentifythecharacteristicfatigue failuresintheengineering structures.
- Knowledgeof connectingfracturemechanicsconceptstofatiguefailure.
- Knowledgeof fatiguefailuremechanismsinnon-metallic materials.

SYLLABUS

Introduction to Fatigue: Introduction and historical overview, Types of fatigue – low cycle fatigue,high cycle fatigue, very high cycle (giga cycle) fatigue, Fatigue test methods and equipment, Totallife approaches based on cyclic stress and cyclic strain, Cyclic hardening and softening in singlecrystalsand poly crystals

TypesofCracks: Crackinitiationandpropagation,Mechanisms,Macrostructuralandmicrostructuralaspects,Useof fracturemechanics in fatigueLocal strain approach, effect of different factors on fatigue – Stress concentration, Size, Surface,Temperature, Frequency, Environment, Microstructure, Residual stresses, Fretting, Creep-fatigueinteraction,Multiaxialstresses,Thermomechanicalloading,

Fatiguebehaviourofdifferentmaterials: Metallic materials and weldments, Ceramics, Polymers, Composites, Metallic glasses,Shape memory alloys, Ultrafine grained materials, Nanocrystalline materials, Biomaterials, MetallicfoamsCasestudiesonfatiguefailures,Designconsiderations,Methodsforfatiguelifeimprovement.

TextBooks:

1.FatigueofMaterials,Suresh,Cambridge India,2015.

Referencebooks:

1.FractureMechanics, FundamentalsandApplications,T.L.Anderson,CRCPress2017.

11.COMPUTATIONALMATERIALSENGINEERING

CourseObjectives:

- Thiscourseintroducescomputationalmethodsinthedomainofmetallurgicalandmaterialsengineering.

CourseOutcomes:

- Analyseametallurgicalproblemtocreateawellposednumericalproblem.
- Identifyinitialandboundaryconditionsofaproblemrelevanttomaterialsdomain.
- Proposeasolutionprocedureforanumericalprobleminthedomainofmaterialsengineering.
- Demonstrateabilitytoquantifyamaterialsengineeringproblemthroughnumericalanalysis.

SYLLABUS

Softwareandlanguagesfornumericalcomputation

1. Linearalgebraicsystems
2. Eigenvalueproblems
3. Curvefitting
4. Root finding
5. Optimization
6. Numericaldifferentiation,numericalintegration
7. DigitalprocessingusingfastFouriertransforms,principalcomponentanalysisetc.
8. Librariesforaccurateandfastnumerical computation

Application of computational methods to study structure of materials at different length scales,transport phenomena, phase transformations and kinetics of reactions. Examples can be drawn fromprocesses and topics covered in corecurriculum of materials engineering .

Textbooks:

1. IntroductiontoComputationalMaterialsScience– RichardLeSar,CambridgeUniversityPress(2013).
2. AppliednumericalmethodsforengineeringusingmatlabandC– R.J.SchillingandS.L.Harris,CengageLearning (2007)

Referencebooks:

1. MathematicalMethodsforPhysicsandEngineering,3rdEdition–R.F.Riley,M.P.Hobson,S.J. Bence, CambridgeUniversity Press (2012).
2. ModelinginmaterialsprocessingJ.A.DantzigandC.L.TuckerIII,CambridgeUniversityPress (2001)

12.SURFACEENGINEERING

CourseObjectives:

- TounderstandtheneedforSurfaceEngineeringandtobecomefamiliarwiththetechniquesassociate dwith SurfaceEngineering.

CourseOutcomes:

- Indicatetheneedforsurface engineering.
- Indicatethedifferent methodsofsurfaceengineering.
- Differentiatebetweenthemethodsusedandindicatetheirrelativemerits.
- Understandaspectsassociatedwithindustrialapplicationsofsurfaceengineering.

SYLLABUS

Need for engineered surface, definition and principlesConventional surfacehardening methods

Methods involving no change in the chemical composition of the surfaceMethodsinvolving changein chemicalcompositionofthesurface

Applicationof advancedtechniquessuchasionandelectronbeamtowardscreatingnewengineeredsurface

Controlledhighqualitysurfacemodificationbytechniquessuchas CVD,PVD,Plasma,laser,ion bombardment

Effect of process variables and structure –property correlationsThermo - chemical, thermo - mechanical and thermal processesTreatments forindustrialcomponentsCasestudies

TextBooks:

1. IntroductiontoSurfaceEngineering,P.A.Dearnley,CambridgeUniversityPress,2017.

ReferenceBooks:

1. BasicsOfSurfaceEngineering,MKamaraju

13.PHASETRANSFORMATIONS

CourseObjectives:

- Tointroducethestudenttokeyconceptsin Phasetransformationsandenableanunderstandingof thesteps involved inseveral important phasetransformations.

CourseOutcomes:

- Classifyphasetransformations
- Indicateimportantstepsindifferenttypesofphasetransformations
- Explainphasetransformationsfromtheperspectiveofthermodynamicsandkinetics
- Describeafewwellknown andstudiedphasetransformations

SYLLABUS

DefinitionandtypesofPhasetransformations.

Diffusion: Fick's laws of diffusion, solution of Fick's second law and its applications, atomic modelofdiffusion and role ofcrystal defects, temperaturedependenceof diffusion coefficient.

Kirkendalleffect.Diffusionaltransformationinsolidsanddiffusionlesstransformationinsolids.

Nucleation and growth - energy considerations; homogeneous nucleation, heterogeneous nucleation,growthkinetics, overall transformation rates.

Crystal interfaces and microstructure. Microstructure evolution including recrystallization and graingrowth.

Precipitation from solid solution: Homogeneous and hetrogeneous nucleation of precipitates, theagingcurve, mechanismsofagehardening, examplesfrom Al-Cu andother alloy systems.

MartensiticTransformations:Generalcharacteristicsofmartensiticreactions,similaritytodeformation twinning, bain distortion, crystallography and kinetics of martensitic transformations,examplesfrom ferrousand non-ferrous alloy systems.

Order-disorder Transformation Examples of ordered structures, long and short range order, detectionofsuper lattices, influenceof ordering on properties.

Spinodaldecomposition.

Textbooks:

1. SolidStatePhaseTransformations,V.Raghavan,PrenticeHallIndiaLearningPrivateLimited, 1987.
2. PhaseTransformationsinMetalsandAlloys,DavidA.PorterandKennethE.Easterling,ThirdEdition, CRCPress, 2017

Referencebooks:

1. PhysicalMetallurgyPrinciples,RezaAbbaschian,LaraAbbaschian,andRobertE.Reed-Hill,Cengage, 2013.
2. MechanismsofDiffusionalPhaseTransformationsinMetalsandAlloys,HubertI.Aaronson,Masato Enomoto, and Jong K. Lee, CRCPress, 2016.

14.INTRODUCTION TOTRANSPORTPHENOMENA

CourseObjectives:

- Thiscoursewillintroducetheconceptsoffluidflow,heattransferandmasstransferwithbehaviorand processingof engineeringmaterialsas the focus.

CourseOutcomes:

- Poseaproblemin transportphenomenaasabalanceequation.
- Makesuitableassumptionsto maketheproblem a well-definedone.
- Identifysuitablegeometryandboundary conditionsfortheproblem.
- Solvesimplepartialdifferentialequationsrelevant totransportphenomena.
- Plotdifferentparameters andinterpretthesolutions.

SYLLABUS

Balanceofquantitiesusingelementalvolumeapproach,continuityequation

Newton'slawofviscosity,Navier-Stokesequation,laminarflowproblems,exactsolutionsinrectangular,cylindrical and spherical coordinate systems

Frictionfactors,correlationsforturbulentregime,Darcy'slaw,flowthroughporousmedia.

Fundamentalsofheatconduction,convection,radiationandtheircombinedeffect;steadyandunsteadyheatt ransfer,exactanalyticalsolutions, correlationsfor conjugate heattransfer.

Diffusionanditsapplicationinsolidstate,convectivemasstransfer,unsteadydiffusioninfiniteandinfinitebodie s, diffusion and chemical reactions.

Coupledphenomenaintransport,Non-dimensionalnumbersandtheircorrelationsofdifferentregimesand analogies.

Textbooks:

1. Transportphenomena,2ndEdition:R.ByronBird,WarrenE.StewartandEdwinNLightfoot; John Wiley & Sons.
2. FundamentalsofMomentum,HeatandMassTransfer,4thEdition:JamesR.Welty,CharlesE. Wicks,RobertE.Wilson andGregory Rorrer; JohnWiley &Sons.

Referencebooks:

1. Transportphenomenainmaterialsprocessing:D.R.PoirierandG.H.Geiger,TMS
2. IntroductiontoFluidMechanics,5thEdition:RobertW.Fox&AlanT.McDonald:JohnWiley &Sons.

15.PHYSICSOFMATERIALS

CourseObjectives:

- To understand the science behind the properties exhibited by materials. To recognize the sizescalefromwhichthepropertyoriginatesandhencetheimpactofvariousmaterialconstituentson the properties of thematerials.

CourseOutcomes:

- Explaintheorigin ofthe various propertiesofmaterials.
- Indicatethephenomenathat impactspecificproperties.
- Usequantummechanicalapproachtoexplainmaterialproperties.
- Utilizereciprocalspace.
- Explainthesimilaritiesanddifferencesbetweenclassicalparticles,Fermions,andBosons

SYLLABUS

Overviewofpropertiesofmaterials

ThermalexpansionElectricalConductivity,Measuringelectricalconductivity Freeelectrongas,idealgas.

Freeelectrontheoryofmetals,Wiedemann-Franzlaw,Drudemodel,SuccessesandLimitationsofDrudemodel, Sourceof limitations of Drudemodel.

LargesystemsandStatisticalMechanics,MaxwellBoltzmannstatistics

ClassicalParticles,Quantumparticles,Historyof quantummechanics,Drude-Sommerfeldmodel

Fermi-DiracStatistics,FeaturesofFermi-DiracDistributions,comparisonwithMaxwell-Boltzmannstatistics

AnisotropyandPeriodic potential,ConfinementandQuantization,Densityofstates

FermiEnergy,FermiSurface,FermiTemperature,ElectroniccontributiontoSpecificHeatatConstantVolume Reciprocal space

Calculatingallowedandforbiddenenergylevels,Freeelectronapproximation,tightbindingapproximation

Electroncompounds,Semiconductors,Optoelectronicproperties,magneticproperties,phonons

Superconductivity,Bose-Einsteinstatistics,Meissnereffect,BCStheory,Physicsofnanoscalematerials.

TextBooks:

1.PhysicsofMaterials,EssentialconceptsofSolidStatePhysics.PrathapHaridoss,Wiley2015.

Referencebooks:

1. SolidStatePhysics,AshcroftandMermin,Cengage2003.

SYLLABUSOFOPENELECTIVES

1. MATERIALSCHARACTERIZATION

Courseobjectives:

- Toobtainknowledgeonvariousstructuralandmicrostructuralcharacterizationtechniquesofmaterials.
- Tostudytheprinciples,theory andpracticeofvariouscharacterization techniques

CourseOutcomes:

- Determinecrystalstructureofmaterials
- Analysemicrostructureofmaterialsatdifferentlengthscales
- To use XRD to study grain size, phase diagram and residual stresses
- To use XRD to determine chemical composition and order-disorder transformation

SYLLABUS

Metallography- Macro and Micro examination of examination of metals and alloys, Resolutionandmagnification. Construction ofoptical microscope

Principlesofconstructionofelectronmicroscopes.Specimenpreparationtechniquesfortransmissionelectron microscopy.

Production and properties of X-rays, Electromagnetic radiation, continuous and characteristicsspectrum,absorption.Filters.Diffraction.Bragg'slaw,scatteringbyatom,Structurefactorcalculations.

Diffraction Methods: Laue's method, rotating crystal method, powder method, Determination ofcrystalstructure,determinationofprecisionlattice parameter,sources oferrorinmeasurements.

Applications of XRD – Effect of plastic deformation. Determination of particle size, grain size,residualstresses, determination ofphasediagrams, order-disorder transformation.

Textbooks:

1. ElementsofX-raydiffraction:B.D.Cullity,PearsonEducation 2014
2. Electronandanalysis:P.J. Goodhew,J.Humphreys,R.Beanland,3rdedition,CRCPress2000.

2. METALJOININGPROCESSES

Courseobjectives:

- Todevelopunderstandingfundamentalsofwelding
- Toknow the requirements of Joining a material
- To know the various types of joining processes

Courseoutcomes:

- Able to select welding process for the given application
- Identify differentenergysourceslikeelectronbeam,laser beam,plasma arc,explosionwelding,ultrasonicweldingetcandanalyzetheconcept,mechanism,parametersassociatedwith theprocesses
- Demonstrate weld design procedures and can also Describe soldering and brazing techniquesconvincingly

SYLLABUS

Introduction:Importanceandclassification.Basicconceptsinarcweldingandgaswelding.

General theory of arc welding. Principle, operation and application of shielded metal arc welding.Tungsten inert gas , plasma arc,submerged arc, metal inert gas and CO_2 welding processes. Electro-slagwelding.

Resistanceweldingprocesses.Spot,seam, projection

Specialweldingprocesses Thermitwelding,Electronbeamandlaserbeamwelding.

Solid state welding processes.Diffusion bonding, ultrasonic.Explosive inertia/friction welding.Solderingand brazing.

Textbooks:

1.Weldingand WeldingTechnology,R.L.Little

ReferenceBooks:

1. WeldingTechnology,N.K.Srinivasan

3. POWDERMETALLURGY

Courseobjectives:

- Thiscourseintroducestheparticulatetechnology tocreatecomponentsfrom powderroute.
- Tobuildthenecessarybackgroundofemergenceandimportanceofpowdermetallurgyscopeand limitations.
- Obtainanecessaryknowledgeaboutvariouspowderproductiontechniquesandcharacteristics.
- Obtainaworkingknowledgeofcompactionandsinteringtechniques.

- Gainaneffectiveknowledgeof applicationsofpowdermetallurgyproducts.

CourseOutcomes:

- Appreciatetheimportanceofpowdermetallurgytechnologyforproductionofmaterialsandcomponents in comparison with otherfabrication techniques.
- Listouttheadvantages,limitationsandapplicationsofpowdermetallurgytechnique.
- Abletochoosetheproductionmethod toget therequiredsizeandshapeof thepowders.
- Knowledgeofvariouscharacterization methodstocontroltheproperties of thepowders.
- Describesthe consolidationandsinteringprocessesinpowdermetallurgyroute.
- Candevelopanddesignpowdermetallurgicalcomponentsforspecificapplicationsandneedsof various industries.

SYLLABUS

Introduction: Advantages and limitations of powder metallurgy.

Powder production methods:

Mechanical, Chemical, Electrolytic and atomization Methods.Commercial production of metallic powders.

Powder characteristics:

Composition and structure, particle size, shape, specific surface, surface topography, flow rate, apparent and tap density, pressing properties.

Compaction of metal powders:

Pressure and Pressureless compaction techniques: Die compaction, Cold Isostatic pressing, Powder rolling, Powder forging, Explosive forming; High Temperature Compaction methods: Hot Pressing, Hot Extrusion, Spark Plasma Sintering, H I P.

Principles and practice of sintering:

Sintering mechanisms, stages of sintering, Driving forces for sintering, sintering atmospheres, Liquid phase sintering, Post sintering operations.

Applications of powder metallurgy: Cermets, bearing materials, dispersion strengthened materials and other miscellaneous applications.

Textbooks:

1. Powdermetallurgy:science,technologyandmaterialsAnishUpadhyaya,G.S.Upadhyaya,UniversitiesPress
2. Powermetallurgy:science,technologyandmaterials– P.C.Angelo,R.Subramanian,PrenticeHallIndiaLearning Pvt.Ltd.

Referencebooks:

1. Volume7:PowderMetallurgy,ASMHandbook–P.K.SamalandJ.W.Newkird
2. PowderMetallurgyScience–R.M.German,Metal PowderIndustry

4.FAILUREANALYSIS

CourseObjectives:

- Tohighlightfactors governingthe failureof materialsandtypes offailure
- Toevaluatethemechanismsand environmentaleffectsassociatedwithfailure
- To identify various failures in heat treatments, and deformation processing, andmethodsto prevent them

CourseOutcomes:

Aftercompleting thiscoursethestudentwillhave:

- Theabilitytoidentifythetypesoffailuresin engineeringcomponentsunder service
- Knowledgeofthetoolsand techniquestoperformfailureanalysis
- Theskillsettoperformfractographicanalysisaftervariousfailures
- Theabilitytoidentifydifferentfailuremechanismsresultingfrommanufacturingprocesses
- Sourcesof Failures,StepsinFailureAnalysis,

SYLLABUS

Characteristics of ductile and brittle fracture, ductile to brittle transition.High temperature

failures,Fatiguefailures,

Corrosionfailuresandtheiridentification,

Failures of industrial components like casting and welding.Somecasestudies in failureanalysis.

TextBooks:

1. AnalysisofMetallurgicalfailures-VJCollangelo andPAHeiser

ReferenceBooks:

1. MechanicalMetallurgyDieter

5.INTRODUCTIONTOMATERIALSENGINEERING

CourseObjectives:

- To give the students a broad overview to various aspects of Materials Science andEngineering.In stillinterest and curioinstrusity in thediscipline.

CourseOutcomes:

- Haveabroad knowledgeof thediscipline.
- Haveanexposuretomethodsand techniquesusedinthediscipline.
- Understandthe flowofcoursesthrough therestoftheirundergraduate education.
- Develop a preliminary understanding of which courses address which topics in thediscipline.

SYLLABUS

Design,synthesis&processing,characterization,applicationsofmaterialsFailureanalysis&forensics of different types of materials starting from common metals and alloys to exotic materials.Examplesand casestudies will betaken up andshown to the students.

Demonstrationsusingsophisticatedandstate-of-the-artinstrumentspertainingtoaspectsofsynthesis,processing,characterizationandfailureanalysiswillbecarriedoutinthelaboratories.

Comprehensive visits/conducted tours to the research laboratories will be carried out Videos andsimulationsdescribingmaterialsandtheirpropertieswillbeshownalongwithspecificandinterestingcasestudies.

Textbooks:

1. MaterialsScienceandEngineering:An Introduction:WilliamDCallister;Wiley,2014
2. MaterialsandDesign:TheArtandScienceofMaterialSelectioninProduct Design,Mike
3. AshbyandKaraJohnson, 3rdEdition,Butterworth-Heinemann,2014.
4. Engineering Materials 1 (2011) and 2 (2012), D.R.H. Jones and M.F. Ashby, 4th Edition,Butterworth-Heinemann.

Referencebooks:

1. The New Science of Strong Materials or Why You Do Not Fall Through The Floor, J.E.Gordon.Penguin, 1991.
2. 2.StuffMatters, MarkMiodownik. Penguin, 2014.

6.MATERIALSTHERMODYNAMICS

CourseObjectives:

- To highlight the fundamental role of Thermodynamics in describing metallurgical andmaterials processes. To learn and use thermodynamic functions, rules and relations andinterpretthermodynamicplots and diagrams.

CourseOutcomes:

- Usethevariousthermodynamicfunctionsappropriatelyunderdifferentexperimentalsituationsinvolving gases, liquids and solids
- Deriveandexplainthe GibbsPhaserule
- UtilizeEllingham diagrams
- UtilizePourbaixdiagrams

SYLLABUS

History of thermodynamics, Ideal Gas, Energy and Work, Extensive and Intensive

PropertiesFirstLawofThermodynamics,

InternalEnergy,Enthalpy,HeatCapacity,ReversibleProcesses

Second Law of Thermodynamics, Entropy and equilibrium, Reversibility, Heat EnginesStatisticalInterpretationof Entropy, BoltzmannEquation

AuxiliaryFunctionsEnthalpy,FreeEnergy,ChemicalPotential,Maxwell'sEquations,Gibbs-

HelmholtzEquation

Enthalpy as a Function of Temperature and Composition, Third Law of ThermodynamicsPhase Equilibrium in a One-Component System, Equilibrium between Vapor andCondensedPhase, and between condensed phases

Gases:Ideal,Real,vanderWaalsRaoult'sLaw andHenry'sLaw,Activity,Gibbs-DuhemEquation.

PropertiesofIdealandNon-idealSolutions,RegularSolutionsActivity,PhaseDiagramsofsomeBinarySystems.

EffectofTemperatureand Pressureonthe EquilibriumConstantforagasmixture

EllinghamDiagramsThe GibbsPhaseRule

Electrochemistry,ConcentrationandEMF,StandardReductionPotentials,PourbaixDiagrams

Textbooks:

1. Introduction to Thermodynamics of Materials, 5th Edition, David R Gaskell, Taylor andFrancis,2016.
2. MaterialsThermodynamicswithEmphasisonChemicalApproach,Hae-GeonLee,WorldScientificPublishing, 2012.

Referencebooks:

1. ThermodynamicsinMaterialsScience,RobertDeHoff,CRCPress,2006.

7.IRONMAKINGANDSTEELMAKINGTECHNOLOGY

Courseobjectives:

- Thiscourseintroducestheprinciplesof ironmakingandsteelmaking

CourseOutcomes:

- Describethephysicalandchemicalprocessesthattakeplaceduringironmakingandsteelmaking
- Analysetheeffectofchangeinprocessparametersinironmakingandsteelmakingprocesses
- Describethemethodsforcontrolof qualityinironandsteel production
- Solvenumericalproblemsinvolvingreactionkineticsandcompositioncontrol

SYLLABUS

Principles of Iron making and steelmakingFeasibilityofreactionsandchemicalkinetics

Ironmakingthrough blast furnace route ,steady state heat and material balance in blast

furnaceEffectof different process parameterson theproductivity and qualityof pig iron

AlternatemethodsforreductionofironSteelmakingprimaryprocess:pneumaticandhearth,secondarysteelmaking,qualitysteelmaking,deoxidation, inclusion.

Controlofcompositionandqualityofsteelusingslags:ferrousslags,physicalchemistryofslagmetal reactions

Textbooks:

1. Afirstcourseiniron andsteelmaking,DipakMazumdar,Orient BlackswanPvt.Ltd.,(2015)

2. Ironmakingandsteelmaking:TheoryandPractice,GhoshAhindra,ChatterjeeAmit,PhiLearningPrivate Limited,(2001)

Referencebooks:

1. ExtractiveMetallurgy1: BasicThermodynamics andKinetics,Alainignes(ISTELtd.,)
2. ExtractiveMetallurgy2:MetallurgicalReactionProcesses,AlainVignes (ISTELtd.,)
3. ExtractiveMetallurgy3:ProcessingOperationsandRoutes,AlainVignes(ISTELtd.,)
4. Anintroductiontomodernsteelmaking,R.H.Tupkary,KhannaPublishers(2000)
5. Anintroductiontomoderniron making,R.H.Tupkary,KhannaPublishers(2004)

8.MATERIALSPROCESSING

CourseObjectives:

- Tounderstandthefundamentalsofdeformationprocessingrelatedtovariousmanufacturingprocesses
- Toobtain knowledgeof various metal joining processesofvariousengineering alloys
- Tounderstandconceptsassociatedwithsolidificationanditsphysicalmetallurgy
- Toobtainthebasicknowledgeofprocessingofceramicandglassymaterialsandtheircomparisonwith other materials

CourseOutcomes:

- Relatethetheoryofplasticitytovariousdeformationprocessingmethods
- Identifythevariousmaterialsjoiningprocessesandtheirapplications
- Indicatethejoiningprocessesofceramics andglassymaterials

SYLLABUS

Principles of plasticity related to metal forming: cold, warm, and hot working,dynamic recoveryandrecrystallization.BasicmetalformingprocessessuchasRolling,Forging,Extrusion,WireDrawing,Sheetmetalworking.

Welding versus other joining processes: Welding processes, welding metallurgy,TTT and CCTdiagrams,carbonequivalent,welding offerrousand non-ferrousalloys,joiningofdissimilarmetals

Casting: Thermodynamicsofsolidification,Nucleationandgrowth,undercooling,dendriticgrowth,structureofcastingsandingots,heattransferduringsolidification,typesofcastingprocesses.

Structureofceramicsandglassymaterials:ceramicpowderpreparations,formingandconsolidationprocesses.Comparison ofprocessing andapplications ofdifferentmaterials

Textbooks:

1. PrinciplesofmetalcastingbyR.W.Haine,C.Loperandp.C.Rosenthal.mcgrawhilleducation,2001

ReferenceBooks:

1.Introductiontoceramicsbykingery,Bowen,Uhlman.Wileyindiapvtlimited,2012

9. INTRODUCTION TO

INSTRUMENTATIONCourseobjectives:

- TolearntheprincipleofPressure,Temperature,flow,level,densityandviscositymeasurements.
- Toknowabouttheselection,calibrationandinstallationof differentinstruments
- Toexplorethe applicationofmeasuringinstrumentsinvariousindustries

Courseoutcomes:

- ApplytheknowledgeofvariousMeasuringInstrumentstodesignasimpleInstrumentationsystem.
- Calibratetheindustrialinstruments andusethem invariousfields.
- Selectsuitableinstrumentforagiven application
- AnalyzingtheinstrumentinIndustry
- PerformCalibrationof Instruments
- Design Instrumentation Circuitsformeasurementsystems.

SYLLABUS

Basic concepts.Introduction.Definition of terms.Calibration standards.Generalized measurementsystem.Basicconceptsindynamicmeasurements.Causesandtypesofexperimentalerrors.Analysis.

Transducerandelectricsensingdevices.Differentialtransformer.Capacitive,piezoelectric,photoconductivea nd ionization transducers.

Pressure measurement:Mechanicalpressure measurementdevices.Low pressure measurement.McLeodgauge-Pirani Thermal conductivegauge- Ionization gauge. Flowmeasurementmethods.

Temperaturemeasurement:bymechanicalandelectricaleffects-Measurementbyradiation.Transientresponseof thermal systems.Highspeedtemperaturemeasurement.

Strainmeasurement:Straingauges.Temperaturecompensation.Straingaugerosettes.

Textbooks:

1. ExperimentalmethodsforEngineers,J.P.Holman, McGraw HillPublication.
2. Mechanicalmeasurements,Sirohi,Radhakrishnam.
3. ElectronBeamAnalysisofmaterials,Lorento

10.FLUIDMECHANICSANDHEATTRANSFER

Courseobjectives:

- Identifyandobtainvaluesoffluidpropertiesandrelationshipbetween them.
- Understandtheprinciplesofcontinuity,momentum,andenergy asappliedto fluidmotions.
- Recognizetheseprinciples writteninform ofmathematicalequations.
- Applytheseequationstoanalyzeproblemsbymakinggoodassumptionsandlearnsystematicengine ering method tosolvepractical fluidmechanics problems.
- Applyfundamentalprinciplesoffluidmechanicsforthesolutionofpracticalcivilengineeringproble ms ofwaterconveyanceinpipes, pipenetworks,and open channels.

Courseoutcomes:

- TheStudentwillbeacquaintedwiththeprinciplesrelatingtothemeasuringequipmentoffluid flow.
- Furtherthestudentiscapableofunderstandingthebasiclawsoffluiddynamicsandtheirapplicationst o the engineeringproblems occurring duringtheirpractice.

SYLLABUS

Classification of flows : Steady, Unsteady, Uniform, Non-uniform, Laminar, Turbulent, Rotational,Irrotationalflows,Vorticity,andciruculation-Conservationofmass-Equationofcontinuity,Conservation of momentum- Euler's equation, Conservation of energy– Bernoulli's equation and itsapplications.

One-dimensional Viscous flow.Couette flow - Plane couetee flow. Two Dimensional Viscous Flow:Navierstokesequations and solutions.

LaminarBoundaryLayer.Momentumintegralequation:Flowoveraflatplate-Displacementthickness,Momentumthicknessandenergythickness.TurbulentBoundaryLayer.Laminar–Turbulenttransition -Momentumequations and Reynold'sstresses.

DimensionalAnalysisandModelingSimilitude.Fundamentalandderiveddimensions–Dimensionlessgroups – Buckingham ¶-theorem– Raleigh method.

Elementsofheattransmission.Steadystateconduction:convectionandradiation.Furnaces.Classification of furnaces and their use in metallurgical industries.Heat utilization in furnaces,available heat, factors affecting it.Heat losses in furnaces and furnace efficiency.Heat balance andSankeydiagrams. Principles ofwaste heat recovery.

Recuperatorsandregenerators.Typesandapplicability.AMTDandLMTDinrecuperators.Protectiveatmosphere and theirapplications.Salt bathfurnaces.

Textbooks:

1. FluidMechanics, A.K.Mohanty,PrenticeHallof IndiaPvt.Ltd.
2. Fuels,furnacesandrefractoriesbyO.P.Gupta

Referencebooks:

1. FluidMechanicsand HydraulicMachines, R.K.Bansal,LaxmiPublications.
2. FoundationsofFluidMechanics,Yuan,PrenticeHallof India.
3. FluidMechanics anditsapplications,S.K.GuptaandA.K.Gupta,TataMcGrawHill,NewDelhi.

11. ENGINEERINGMECHANICS&STRENGTHOFMATERIALS

Courseobjectives:

- Thestudentwillbegivenmaximumflexibilityinanareasof DynamicsandVibrations-itsinterfacesto materials and structuresforunderstanding on applications.

- Towardscharacteristicsofstructuresandstudyonmaterialandstructureand AppliedMathematics and Numerical Methods, Experimental Mechanics and Materials, Strength ofmaterials& structural analysis

Courseoutcomes:

- After completing the course student will have the basic knowledge on material and structuresatanalysis level.
- Thiswillalsointegratethescience,engineeringandmathematicalconceptforstudentunderstanding

SYLLABUS

Concurrentforcesinaplaneanditsequilibrium Centroidsofcompositeplanefigures.Generalcaseofforces in a plane.

Momentofinertiaofplanefigures.Parallelaxistheorem.PolarMI.ConceptofmassMI.Rectilineartranslatio n.

Kinematics.Principle of dynamics.Motion of a particle under constant force.Force proportional todisplacementand freevibrations (SHM) .

D'Albert'sprinciple.Momentum.Impulse work and energy.Rotation of a rigid body about a fixedaxis kinematics.Equation of motion of a rigid body about a fixed axis.Rotation under constantmoment.Torsional vibration.

Simple stresses and strains: Stresses on inclined plane.2-Dimensional stress systems. Principal stressand principal planes.Mohr's circle. Shearing force and bending moment. Types of loads.Types ofsupports.SF and BM diagrams for formula. Bending stresses in the above types of beams withrectangularandcircularsections.Torsion ofcircularshafts.Determinationof shearstress.

Textbooks:

1. EngineeringMechanics–S.Timoshenko(relevantsectionsonly)
2. ElementsofStrengthofMaterials-S.Thimoshanko(relevantsectionsonly)

ReferenceBooks:

1. EngineeringMechanics–S.Timoshenko(relevantsectionsonly)
2. ElementsofStrengthof Materials-S.Thimoshanko(relevantsectionsonly)

12.ELECTRICALTECHNOLOGY

Courseobjectives:

- Understandthebasicprinciplesofoperationofrotatingelectricmachines(GeneratorsandMotors),t heirclassificationand basicefficiency and performance characteristics.
- Understandtheoperationandbasicconfigurationsofseparatelyexcited,permanentmagnet,shunta nd series DC machines and speedcontrol methods.
- Toknowthe basicprincipleofsinglephasetransformers anditsperformance.

- Tounderstandthebasicprincipleofthree-phaseinduction motorandalternators
- Tounderstandthebasic principleofspecialmotorsandelectrical instruments.

Courseoutcomes:

- Studentwillbeableto analyzetheperformanceof DC Generatorsand DCMotors.
- Studentwillbeable toanalyzethe performanceof transformers.
- Studentwill beableto learn in-depthknowledgeon threephaseinduction motor.
- Studentwillbeable toanalyzethe performanceof specialmotors andelectricalinstruments.

SYLLABUS

Magneticcircuits:Definitionsofmagneticcircuit,Reluctance,Magnetomotiveforce(m.m.f),magneticflux,simpleproblems onmagneticcircuits, Hysteresisloss(Chapter8, PageNos.155-175)

Electromagneticinduction:Faraday'slawofelectromagneticinduction,inducedE.M.F.,DynamicallyinducedEMF.StaticallyinducedEMF,Self-inductance,andmutualinductance.(Chapter9, PageNos.176-190)

D.C. generators. D.C. Generator principle, construction of D.C. generator, E.M.F. equation of D.C.generator,typesofD.C.generators,Armaturereaction,LossesinD.C.generator,Efficiency,characteristics of D.C. generators, Applications of D.C. generator. (Chapter 10, 11, Page Nos.208-238)

D.C. Motors:D.C. Motor principle, working of D.C. Motors, significance of back E.M.F., TorqueequationofD.C.motors,typesofD.C.motors,characteristicsofD.C.motors,speedcontrolmethodsofD.C.motors,ApplicationsofD.C.motors,TestingofD.C.machine:lossesandefficienc6y,Direct loadtestandSwinburne's test(Chapter12,13,PageNos.239-267).

A.C. Circuit: Introduction to steady state analysis of A.C. circuits. Single and balanced 3 phasecircuits. (chapter16,PageNos.323-348)

Transformers: Transformerprinciple,EMFequationoftransformer,Transformeronload,EquivalentcircuitofTransformer,Voltageregulationoftransformer,lossesinatransformer,Calculation of efficiency and regulation by open circuit and short circuit tests. (Chapter 20, PageNos.423-455)

Threephaseinductancemotor: Inductionmotorworkingprinciple.Constructionof3phaseinduction motor, principle of operation.Types of 3 phase induction motor, Torque equation ofinductionmotor,Slip-Torquecharacteristics,StartingTorque,Torqueunderrunningcondition,Maximum Torque equation, power stages of induction motor, efficiency calculation of inductionmotorbydirect loading (Chapter21, Pg 463-489).

Alternator: Working principle, EMF equation of Alternator, Voltage regulation by Sync.Impedancemethod.(Chapter23, PageNos.505-515)

Synchronous Motor: Synchronous motor principle of operation., Construction, Methods of startingofsynchronous motor.(Chapter24, PageNos.516-526)

Electricalmeasurements:Principlesofmeasurementofcurrent,Voltagepowerandenergy,Ammeters, Voltmeters, Wattmeter's ,Energy Meters, Electrical conductivity Meter, PotientiometerandMegger.

Textbook:

1.ElementsofElectricalEngineeringandElectronicsby V.K.Mehta,S.Chand&Co.

Referencebook:

1. AfirstcourseinElectricalEngineering,byKothari

SYLLABUS OF HSS ELECTIVES

1. ORGANIZATIONALBEHAVIOUR

CourseObjectives:

- Tounderstandthebasicconceptsoforganisationalbehaviour,itsfoundationsandimportance.
- Toenablestudentstohaveabasicperspectiveof MotivationandMotivationtheories.
- To acquaint the students about group behaviour in organizations, including communication,leadershipconflictsandorganizationalchangeandhowthesearelinkedtoandimpactorganizationalperformance.

CourseOutcomes:

- Indentifyingfundamental aspectsoforganizationaldynamics.
- Evaluatemaintheoriesof motivationandformulating suitablemotivationalstrategies.
- Analyzethebehaviourof individualsandgroupsin organizations.
- UnderstandingofLeadershiptheoriesandLeadershipbehaviour.
- Applyrelevanttheories, conceptstoaddressimportantOrganizationalBehaviourquestions.
- UnderstandthenatureandroleofOrganizationalBehaviouranditsrelevancetotheworkplace.
- AnalyzeandcomparedifferenttheoriesofMotivationanddesignstrategiestoimprovemotivationat the workplace.
- Gaininsightsofgroupdynamicsanddemonstrateskillsrequiredforteambuilding.Examinefactors which influencegroupcohesiveness and performance.
- IndentifythevariousLeadershipStylesandadoptsuitablestyle.
- Communicateeffectivelyinoralandwrittenforms.
- Developappropriatemethodsandstylesofcommunicationfortheorganization.
- Adoptstrategiesformanaging conflictsinorganizations.
- ImplementOrganizationalchangeinaplannedwayandovercomeresistancetochangeifany.

SYLLABUS

OrganisationalBehaviour : Concept ofOrganisation -Concept of Organisational Behaviour -Nature of Organisational Behaviour - Role of Organisational behaviour - Disciplines contributing toOrganisationalBehaviour.

Motivation: Definition - Nature of Motivation - Role of Motivation - Theories of Motivation :Maslow'sNeedHierarchyTheory,Herzberg'sMotivationHygieneTheoryandMcGregor'sTheoryXand TheoryY.

Group Dynamics: Meaning - Concept of Group -Types ofgroups -Formal and Informal groups - Groupdevelopment -Group cohesivenessandfactors affectinggroupcohesiveness.

Leadership: ConceptofLeadership-DifferencebetweenLeadershipandManagement-Importance ofLeadership - Leadership styles: Autocratic leadership, Participative leadership andFreeRein leadership.

Communication: Meaning - Communication Process - Forms of communication: Oral, Written andNon- Verbal communication - Direction of communication : Downward, Upward and

Horizontalcommunication.

Organisationalconflicts: Conceptofconflict-Reasonsforconflict-TypesofConflict:Intrapersonalconflict,Interpersonalconflict,Intragroupconflict,Intergroupconflict,Interorganisational conflict-Conflict management.

Organisational Change: Nature - Factors inOrganisational change -Planned change: Process ofplanned change - Resistance to change: Factors in resistance to change - Overcoming resistance tochange.

TextBooks:

1. L.M.Prasad:OrganisationalBeaviour,SultanChand&Sons, NewDelhi -110002
2. K.Aswathappa: OrganisationalBehaviour,HimalayaPublishing House,NewDelhi

ReferenceBooks:

1. StephenRobbins: OrganisationalBehaviour,PearsonsEducation,NewDelhi.

2. INDUSTRIALMANAGEMENTANDENTREPRENEURSHIP

CourseObjectives:

- Torelatethe conceptsof Managementwithindustrialorganizations.
- Toexplainthefactorsaffectingproductivityandhowproductivitycanbeincreasedinan Industrialundertaking.
- Tosetforthabasicframeworkforunderstanding Entrepreneurship.

CourseOutcomes:

- Understandthe roles,skillsandfunctionsofmanagement.
- Distinguishthedifferenttypesofbusinessorganizations.
- IdentifythefactorsinvolvedinProductionOperationsManagement.
- Diagnoseorganizationalproblemsandtakesuitabledecisions.
- EstablishgoodHumanResourceManagement practices.
- Acquirenecessaryknowledgeand skillsrequiredfororganizing andcarryingout
- Understandthenatureandfunctionsof Management.
- Abilitytoplan,organize,direct,controlandcoordinateorganizationalactivities.
- Categorizebusinessorganizationsonthebasisofownershipandfunctioninganddeterminethechoiceofan appropriate form ofbusinessorganization.
- Understandandevaluatethekeyentrepreneurialskills neededtoinitiateanddevelopasuccessfulbusiness.

- Analysevariousfactorsforselectingthe locationforaBusinessEnterprise.
- ApplyBreak-evenanalysistotakemanagerialdecisions.
- DesignandformulatevariousHumanResourceManagementprocesses.
- Raisenecessarycapitalfromdifferentsources.
- Designeffectivemarketingstrategies.
- UnderstandtheinstitutionsthataidEntrepreneurshipdevelopment.
- Acquirethe abilityto promoteabusinessenterprise.

SYLLABUS

Management :-Definition, Nature andImportance ;Functions of theManagement; Levels ofManagement;F.WTaylor'sScientificManagement;HenryFayol's PrinciplesofManagement;

Forms of Business Organizations: Introduction, Types of Business organizations, Private Sector- Individual Ownership, Partnership, Joint stock companies and Co-Operative organizations Publicsector- Departmental Organizations, Public Corporations andGovernment Companies. The JointsectorManagement.

ProductionandoperationsManagement: Plantlocation-Factorstobeconsideredintheselectionof Plantlocation;Break-evenanalysis-Significanceandmanagerialapplications;Importance of Production Planning and Control and its Functions;Human Resource Managementand Functionsof HumanResource Manager (in brief);Functionsof Marketing;MethodsofRaisingFinance.

Entrepreneurship: Definition,CharacteristicsandSkills,TypesofEntrepreneurs,Entrepreneur vs. ProfessionalManagers, ,Growth of Entrepreneurs,Nature andImportanceofEntrepreneurs,WomenEntrepreneurs,ProblemsofEntrepreneurship.

Entrepreneurial Development and Project Management: Institutions in aid of EntrepreneurshipDevelopment, Idea generation: Sources and Techniques;, Stages in Project formulation ;Steps forstartingasmallenterprise-Incentives forSmallScaleIndustriesby Government.

TextBooks:

1. Sharma,S.C,andBanga,T.R.,IndustrialOrganization&EngineeringEconomics,KhannaPublishers,Delhi, 2000.
2. VasantDesai,TheDynamicsofEntrepreneurialDevelopmentandManagement(PlanningforfutureSustainable growth),HImalayan Publishing House, 2018.

ReferenceBooks:

1. Aryasri,A.R.,ManagementScience, McGrawHIllEducation(IndiaPrivateLimited,NewDelhi 2014.
2. Sheela,P.,andJagadeswaraRao,K.,Entrepreneurship,ShreePublishingHouse,Guntur,AndhraPradesh, 2017.

3. OPERATIONSRESEARCH

CourseObjectives:

- Formulatea realworldproblem asamathematicalprogrammingmodel.
- Provideknowledgeofoptimizationtechniquesandapproaches.
- Understandandstudyinventoryproblems.
- Knowthe networkmodels.
- Putonknowledgeinsolving replacementproblemsanddifferentqueueingmodels

CourseOutcomes:

- Learnedtotranslatea real-worldproblemintoamathematicalformulation.
- FormulateandSolveTransportation,Assignment andsequencingproblems.
- Resolveinventoryproblems.
- Ableto solve maximum flow and shortest path problems.
- Capabletosolve replacementproblemsand analyzequeueingmodels.

SYLLABUS

Introduction: DefinitionsofOperationsResearch;PhasesofOperationsResearch;TypesofOperationsResearchmodels; applications,meritsand demeritsofOperations Research.

Allocation: LinearProgrammingproblemformulation;Basicassumptions;Graphicalsolution;Simplexmethod;Artificialvariabletechnique;Twophasemethod;BigMmethod;Dualityprinciple;Primal and Dual relation.

Transportation: Formulation; Solution methods; Unbalanced transportation problems - North westcornerrule;Leastcostentrymethod;Vogel's approximationmethod;Optimalsolution;degeneracy.

Assignment: Formulation;VariationsinAssignmentproblem;Travellingsalesmanproblem

Sequencing: Sequencing of - *n* jobs through two machines; *n* jobs through three machines; *n*jobsthrough*m*machines; 2jobs through *m*machines.

InventoryControl:Introduction;TypesofInventory;Inventorycosts;Deterministicmodels-Economicorderquantity(EOQ)andEconomicProductionQuantity(EPQ)withandwithoutshortages;Quantity discounts; P system;Qsystem; Inventory control Techniques.

Network Analysis: Network definitions; Time estimates in network analysis; Labeling usingFulkerson's rule; Forward pass computations; Backward pass computations; Project managementusingCriticalPathMethod(CPM)and ProgrammeEvaluationandReview Technique(PERT).

Network Analysis: Network definitions; Time estimates in network analysis; Labeling usingFulkerson's rule; Forward pass computations; Backward pass computations; Project managementusingCriticalPathMethod(CPM)andProgrammeEvaluation andReview Technique(PERT).

Replacement: Introduction, Replacement of items that deteriorate with time - Value ofmoneyunchanging and changing, Replacement ofitemsthatfail completely.

Queueingmodels: Introduction;Singlechannelpoissonarrivals;Exponentialservicetimes;Unrestricte

queue with in finite population and finite population models; Multichannel poissonarrivalsExponential servicetimes withinfinite populationand restrictedqueue.

TextBooks:

1. HamdyATaha,"OperationsResearch-An Introduction" byTAHA,PrenticeHall,2009.
2. F.S.Hiller, G.J. Liberman,B. Nag and P.Basu "Introduction To Operations Research,McGraw Hill Education(India), 2012.
3. S.D.Sharma,"OperationsResearch",KedarnadhRamnadh&Co.,2017

ReferenceBooks:

1. R.Pannerselvam,"OperationsResearch",PHI..
2. RichardBronson,Schaum’sSeries,"OperationsResearch",McGrawHill
3. N.V.S.Raju,"OperationsResearch-Theoryand Practice"BSpublications.