w.e.f. 2018-2019 academic year

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech. 1st YEAR SYLLABUS (w.e.f AY 2018-19)

METALLURGICAL ENGINEEERING

I YEAR I SEMESTER

S. No	Course Code	Code	Course Title	Hours per week			Credits
				L	T	P	
1	BSC	103	Mathematics-I	3	1	0	4
2	BSC	101	Engineering Physics	3	1	0	4
3	ESC	102	Programming for Problem Solving	3	0	0	3
4	ESC	103	Engineering Graphics	1	0	4	3
5	BSC	101	Engineering Physics Lab	0	0	3	1.5
6	ESC	102	Programming for Problem Solving Lab	0	0	3	1.5
			Total Credits	**10**	**2**	**10**	**17**

I YEAR II SEMESTER

S. No	Course Code	Code	Course Title	Hours per week			Credits
				L	T	P	
1	BSC	104	Mathematics-II	3	1	0	4
2	BSC	102	Engineering Chemistry	3	1	0	4
3	ESC	201	Engineering Mechanics	3	1	0	4
4	HSMC	102	English	2	0	0	2
5	BSC	102	Chemistry Lab	0	0	3	1.5
6	ESC	104	Engineering Work Shop	1	0	3	2.5
7	*HSMC		English Language and Communication Skills Lab	0	0	2	1
			Total Credits	**12**	**3**	**8**	**19**

w.e.f. 2018-2019 academic year

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. 2nd YEAR SYLLABUS (w.e.f AY 2018-19)
METALLURGICAL ENGINEEERING

II YEAR I SEMESTER

S. No	Course Code	Code	Course Title	Hours per week			Credits
				L	T	P	
1	BSC	203	Mathematics-III	3	1	0	4
2	PCC-MM		Mineral Dressing	3	0	0	3
3	PCC-MM	206	Physical Metallurgy	3	1	0	4
4	PCC-MM		Thermodynamics and Kinetics	3	1	0	4
5	PCC-MM		Metallurgical Analysis	3	0	0	3
6	PCC-MM		Mineral Dressing Lab	0	0	2	1
7	PCC-MM	207	Metallography Lab	0	0	2	1
8	PCC-MM	309	Metallurgical Analysis Lab	0	0	2	1
9	MC		Environmental Science	2	0	0	0
			Total Credits	**17**	**3**	**6**	**21**

II YEAR II SEMESTER

S. No	Course Code	Code	Course Title	Hours per week			Credits
				L	T	P	
1	ESC	101	Basic Electrical Engineering	3	1	0	4
2	HSMC	202	Economics for Engineers	3	0	0	3
3	PCC-MM	203	Heat Treatment and Phase Transformations	3	1	0	4
4	PCC-MM	202	Principles of Extractive Metallurgy	3	0	0	3
5	PCC-MM	205	Metallurgical Thermodynamics	3	1	0	4
6	ESC	101	Basic Electrical Engineering Lab	0	0	2	1
7	PCC-MM		Principles of Extractive Metallurgy Lab	0	0	2	1
8	PCC-MM		Heat Treatment and Phase Transformations Lab	0	0	2	1
			Total Credits	**15**	**3**	**6**	**21**

w.e.f. 2018-2019 academic year

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. 3rd YEAR SYLLABUS (w.e.f AY 2018-19)
METALLURGICAL ENGINEEERING

III YEAR I SEMESTER

S. No	Course Code	Code	Course Title	Hours per week			Credits
				L	T	P	
1	HSMC	302	Introduction to Industrial Management	3	0	0	3
2	PEC-MM		**Professional Elective – (1)** i) Fuels, Furnaces & Refractories ii) Nanomaterials iii)Computational Materials Engineering	3	0	0	3
3	PCC-MM	202	Mechanical Metallurgy	4	0	0	4
4	PCC-MM	302	Iron Making and Steel Making Technologies	4	0	0	4
5	PCC-MM		Materials Processing - I	4	0	0	4
6	PCC-MM	210	Mechanical Metallurgy lab	0	0	3	1.5
7	PCC-MM	303	Materials Processing Lab -I	0	0	3	1.5
8	PCC-MM		Fuels Lab	0	0	2	1
			Total Credits	**18**	**0**	**8**	**22**

III YEAR II SEMESTER

S. No	Course Code	Code	Course Title	Hours per week			Credits
				L	T	P	
1	OEC-1		**Open Elective - 1** i) Engineering Materials ii) Metallurgy for Non Metallurgists	3	0	0	3
2	PCC-MM		Non Ferrous Extractive Metallurgy	3	1	0	4
3	PCC-MM	304	Materials Processing - II	4	0	0	4
4	PCC-MM	303	Environmental Degradation of Materials	4	0	0	4
5	PEC-MM		**Professional Elective – (2)** i) Alternate routes of Iron and Steel Making ii) Composite Materials iii) Electronic Materials	3	0	0	3
6	PCC-MM	304	Materials Processing Lab -II	0	0	3	1.5
7	HSMC		Advanced Communication Lab	0	0	2	1
8	PCC-MM	303	Environmental Degradation of Materials Lab	0	0	3	1.5
9	MC		Indian Constitution/Essence of Indian Traditional Knowledge	2	0	0	0
			Total Credits	**19**	**1**	**8**	**22**

During Summer Vacation between III and IV Years: Industry Oriented Mini Project

w.e.f. 2018-2019 academic year

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech. 4th YEAR SYLLABUS (w.e.f AY 2018-19)

METALLURGICAL ENGINEEERING

IV YEAR I SEMESTER

S. No	Course Code	Code	Course Title	Hours per week			Credits
				L	T	P	
1.	ESC	401	Introduction to Instrumentation	3	0	0	3
2.	PCC-MM		Material Characterization Techniques	3	0	0	3
3.	OEC		**Open Elective – 2** (i) Corrosion Process and Control (ii)Testing of Materials	3	0	0	3
4.	PEC-MM		**Professional Elective – 3** i) Light Metals & Alloys ii) Fatigue and Fracture Mechanics iii) Failure Analysis	3	0	0	3
5.	PEC-MM		**Professional Elective – 4** i) Surface Engineering ii) Energy Materials iii) Non Destructive Testing	3	0	0	3
6.			Seminar	0	0	2	1
7.			Mini Project	0	0	4	2
8.	Proj-1		Major Project (Phase – 1)				3
			Total Credits	**15**	**0**	**6**	**21**

IV YEAR II SEMESTER

S. No	Course Code	Code	Course Title	Hours per week			Credits
				L	T	P	
1.	OEC		**Open Elective – 3** i)Alloy Steels ii)High Temperature Materials	3	0	0	3
2.	PEC-MM		**Professional Elective – 5** i) Solidification Processing ii) Non Metallic Materials iii) Functional Materials	3	0	0	3
3.	PEC-MM		**Professional Elective – 6** i) Powder Metallurgy ii) Bio Materials iii) Transport Phenomena	3	0	0	3
4.	Project		Major Project (Phase – 2)				8
			Total Credits	**9**	**0**	**0**	**17**

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. I-Semester

L	T	P	C
3	1	0	4

MATHEMATICS-III

Pre-Requisites: Nil

Course Objectives:

Course Outcomes:

To be obtain from Mathematics Department.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

MINERAL DRESSING

Pre- Requisites: Nil.

Course Objectives:

1. Introduce students to the principles of ore comminution, liberation and particle size analysis.
2. Teach students about various methods of concentration/ separation equipments used.
3. Acquaint students quantifying concentration processes and selection of proper mineral dressing cycles.

UNIT–I

Scope and objectives of ore dressing. Sampling of ores by different methods. Theory of liberation of minerals. Crushers: -Jaw, Gyratory, Cone, Rolls and toothed roll crushers. Types of grinding operations- batch and continuous, dry and wet grinding and open circuit and closed circuit grinding. Grinding Mills: Ball mills, theory of ball mill operation, rod and tube mills. Comminution laws: - Rittinger's laws, Kick's law and Bond's law.

UNIT–II

Sizing Techniques: Laboratory and industry practices- Study of laboratory sizing techniques and reporting of sizing data. . Types of screens, Movement of solids in fluids: Stokes and Newton's laws. Terminal velocity and its relation with size. Relation between time and velocity. Relation between distance traveled and velocity. Equal settling ratio, Free and hindered settling ratio. Quantifying concentrating operations: Ratio of concentration, recovery, selectivity index and economic recovery.

UNIT–III

Classification and types of classifiers: Study of settling cones, rake classifier, spiral classifier and cyclones. Heavy media separation: Principles, flow chart, different media used. Heavy media separation using heavy liquids and heavy suspensions. Washability curves of coal. Jigging: Theory of jigging and Jigging machines, Harz, Baum, Denver jig. Design considerations in a jig.

UNIT-IV

Tabling- Basic principle, study of stratification on a table, Wilfred Table. Humphrey's spiral classifier. Basic principles of Magnetic separation processes and electrostatic separation process. Brief description about the working of belt and drum magnetic separator, high tension separator.

UNIT–V

Floatation: Principles of floatation. Factors affecting floatation. Classification of collectors and frothers. Regulators, factors affecting their efficiency. Floatation machines: Pneumatic and mechanical floatation cells. Application of floatation process to Cu, Pb and Zn ores.

Text Books:

1. Principles of Mineral Dressing by A.M. Gaudin.
2. Mineral processing technology-.A. Wills.

References Books:

1. Elements of Ore Dressing by A.F. Taggart.
2. Ore dressing practices- S. K. Jain.

Course Outcomes:

At the end of the course the student will be able to:

1. Recognition of the need of the mineral dressing prior to extraction of metals.
2. Describe the working and construction details of various equipments used in mineral dressing.
3. Assess the efficiency of concentration processes.
4. Select and describe a particular concentration process suitable to the liberation ore.
5. To make a logical link between mineral processing and economics of metal Production.
6. Apply the knowledge learned so as to being capable of understanding advance courses on mineral processing operations and modeling.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. I-Semester

L	T	P	C
3	1	0	4

PHYSICAL METALLURGY

Pre-Requisites: Physics & Chemistry.

Course Objectives:

1. Give basic concepts of material science.
2. The prime objective of this course is to make the student gain an understanding of the relation between microstructural characteristics and properties of metals and alloys.
3. The course also critically focuses on the crystallography, phase transformations that occur in several ferrous and nonferrous metallurgical systems as a function of temperature and composition through phase equilibrium diagrams.

UNIT–I

Structure of Metals, Types of Chemical bonding, Crystal systems, plane and directional indices, transformation of indices, coordination number, relationship between lattice parameter and atomic radius, packing factor and density calculations, interstitial voids.

UNIT–II

Microscopy: Metallurgical Microscope, principles and construction, types of objectives and eyepieces, common defects of lenses, Introduction to electron Microscopy-Principle and operation of SEM, TEM.

UNIT–III

Constitution of Alloys: Necessity of alloying, types of solid solutions, Hume-Rothery's rules. Intermediate alloy phases, electron-chemical compounds, and electron phases.

Strengthening mechanisms: solid solution strengthening, work hardening, precipitation hardening and dispersion strengthening.

UNIT–IV

Equilibrium Diagrams: Experimental methods for construction of equilibrium diagrams, phase rule, Types of Phase diagrams: Binary Isomorphous alloy systems, non- equilibrium cooling, binary eutectic system, peritectic and monotectic reactions. Phase diagrams with intermediate phases and compounds. Types of Nucleation, determination of the size of critical nucleus, equilibrium cooling and heating of alloys, lever rule, miscibility gaps.

UNIT–V

Transformation in solid state, allotropy, eutectoid, peritectoid reactions and order-disorder transformations. Study of important binary phase diagrams: Fe-Fe_3 C, Cu-Zn, Cu-Sn, Pb-Sn, Al-Cu and complex phase diagrams.

Text Books:

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL,1997.

Reference Books:

1. Physical Metallurgy Principles- R.E. Reed Hill.
2. Physical Metallurgy - V. Raghavan.
3. Physical Metallurgy - Vijendra Singh
4. Foundations of Materials Science and Engineering – WF Smith.
5. Metallurgy for Engineers- Clark and Varney.

Course Outcomes:

At the end of the course the student will be able to:

1. Analyze the structure of crystalline materials and calculate the various crystals parameters.
2. Explain the working of metallurgical microscope and its different parts.
3. Explain the necessity of alloys, will identify the different types of alloy phases.
4. Explain the construction and identification of phase diagrams and reactions.
5. Explain the Fe-Fe_3C diagram with invariant reactions etc.
6. Explain the Cu-Zn diagram with invariant reactions etc.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. I-Semester

L	T	P	C
3	1	0	4

THERMODYNAMICS AND KINETICS

Pre-Requisites: Nil

Course Objectives:

1. The prime aim of this course is to apply thermodynamics and kinetics to various metallurgical aspects like Solutions, Phase diagrams, Diffusion, and Ellingham Diagrams.
2. The course is also intended to correlate electrochemical principles with thermodynamics.
3. To provide a consistent picture of thermodynamic concepts when applied to various topics.

UNIT-I

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

UNIT-II

First Law of thermodynamics: Relationship between heat and work, internal energy and the first law of thermodynamics, calculations of work, Heat capacity, reversible adiabatic processes, reversible isothermal pressure or volume changes, of an ideal gas, Joules experiment, Joule- Thompson experiment, Joule-Thompson co-efficient, Enthalpy change with temperature, Kirchhoff's equation. Efficiency of a cyclic process, Carnot cycle, Carnot theorem, Second law of thermodynamics, concept of entropy, Quantification of irreversibility.

UNIT-III

Free energy functions: Purposes of the new functions, definition of Helmholtz and Gibbs free energy change, meaning of thermodynamically possible process, determination of ΔG from thermal data, useful relationships between free energies and other thermodynamic functions, Maxwell's equations and Gibbs-Helmholtz equation.

Third law of thermodynamics: Background of third law, deductions from third law, applications of third law, other methods of obtaining ΔS^0 for a reaction.

UNIT-IV

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

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

UNIT-V

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

Text Books:

1. Introduction to Metallurgical Thermodynamics – D.R. Gaskell.
2. Chemical and Metallurgical Thermodynamics- M.L.Kapoor.

Reference Books:

1. Physical chemistry for Metallurgists – J. Mackowiak.
2. Thermodynamics of solids-R.S.Swalin.
3. Physical chemistry of metals-L.S.Darken & Gurry.
4. Problems in Metallurgical Thermodynamics : G.S Upadhyaya, R.K. Dubey.

Course Outcomes:

At the end of the course the student would be able to:

1. Knowledge of the type of variable that affects heterogeneous reaction rates nucleation, interfacial energy, interface equilibrium and diffusion.
2. Relate 1st and 2nd Law of thermodynamics.
3. Knowledge of enthalpy, entropy and free energy.
4. Understand the principles of kinetics and thermodynamics as applied to rates and equilibrium positions of chemical reactions.
5. Calculate the temperature dependence of rate constants and relate this calculation to activity and fugacity.
6. Determine order of reaction. Explain the central concepts of chemical kinetics. Formulate and solve rate equations for various reactions.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

METALLURGICAL ANALYSIS

Pre-Requisites: Nil

Course Objectives:

1. To know the principles/ qualitative and quantitative analysis of ores, metals, alloys, and refractory materials.
2. To know the principles and working of the various instruments utilized in instrumental analysis.
3. To know the importance of metallurgical analysis in the field of metallurgy.

UNIT-I

Importance of chemical analysis, scope of metallurgical analysis, classification of various methods used in metallurgical analysis. Solution preparations, normality, molarity, molality, Equivalent weight. Dissolution of ores in general, dissolution of metals and alloys.

UNIT-II

Chemical Analysis - Basic Principles - theory of indicators –Conventional solution methods for qualitative analysis of ores, fluxes, slags, metals and refractories.

Qualitative analysis of common non-ferrous alloys such as brasses, bronzes and solders. Estimation of C, S, Si, Mn and P in cast iron and steel.

UNIT-III

Estimation of Cr, Ni, Mo, W and V in alloy steels.

Determination of iron in iron ore, manganese in manganese ores, lime in limestone, fire-assay of precious metals.

UNIT-IV

Instrumental analysis: Importance of instrumental analysis –Comparison with standard wet chemical methods - Fundamental Physicochemical principles involved and equipment required in absorptiometry i.e, colorimetry and spectrophotometry, colorimetric titration.

UNIT-V

Spectroscopy, potentiometry, amperometric titration.

Calorimetric titrations, polarography, conductometry, electro-analysis and flame photometry.

Text Books:

1. S.K.Jain-Metallurgical analysis.
2. Agarwal, B.C. and Jain S.P., A Text Book of Metallurgical Analysis, Khanna Publishers, Delhi - 1963.

Reference Books:

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

Course Outcomes:

At the end of the course the student will be able to:

1. Know the importance of chemical analysis and its fundamentals. Also know how it is related to metallurgical engineering.
2. Distinguish between qualitative and quantitative measurements and compare them. Can also suggest a method for analyzing different materials.
3. Interpret and identify the elements through analysis. Can explain about analysis of precious metals through assaying.
4. Understand the theoretical principles behind modern analytical instrumentation. Apply theory and operational principles of analytical instruments. Select and apply appropriate instrumental methods of analysis to problems in any of the sciences.
5. Develop a range of knowledge relating to instrument operation, observation, measurement and interpretation of results. Convert between wavelength, energy and frequency for light and understand the relationship between absorbed light and color.
6. Assess and choose different methods to identify the nature of the material given.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. I-Semester

L	T	P	C
0	0	2	1

MINERAL DRESSING LAB

Pre- Requisites: Nil

Course Objectives:

This laboratory course is designed to

1. Make the student to learn and demonstrate the usage of crushers and grinders.
2. Learn to conduct concentrate test at laboratory scale.

List of Experiments:

1. Sampling of an ore from the bulk by
   (i) Coning and quartering method.
   (ii) Riffle sampler.
2. Determination of average particle size of a given material by sieve analysis.
3. Verification of Stoke's Law.
4. Size reduction of the given material using Jaw Crusher and determine the reduction ratio.
5. Size reduction of the given material using Roll Crusher and determine the reduction ratio.
6. Size reduction of the given material using Ball Mill and determine the reduction ratio.
7. Determine the grindability index of coal using hard groove grindability machine.
8. Separation of the given material into magnetic and non magnetic particles using magnetic separator.
9. Study of a jig machine.
10. Determination of recovery percentage of the concentrate by Froth- Floatation process.

Course Outcomes:

At the end of the laboratory course the student will be able to:

1. Pick or take a representative amount of sample and conduct sieve analysis.
2. Determine the reduction ratio in crushing and grinding of different materials using various size reduction units.
3. Analyze the grindability of different coals.
4. Separate or concentrate the given materials using magnetic separation and froth flotation processes.
5. Prepare formal laboratory reports.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. I-Semester

L	T	P	C
0	0	2	1

METALLOGRAPHY LAB

Pre-Requisites: Nil

Course Objectives:

The laboratory course helps to:

1. Gain skills of preparation of samples for metallographic examinations.
2. Find and analyze the microstructures of various ferrous and non ferrous materials.
3. Use the suitable metallurgical microscope.

List of Experiments:

1. Preparation and study of Crystal models.
2. Study of various microscopes (Optical microscope, SEM, TEM) and specimen preparation techniques for metallurgical microscope.
3. Metallographic preparation and microstructure evaluation of low carbon steel.
4. Metallographic preparation and microstructure evaluation of medium carbon steel.
5. Metallographic preparation and microstructure evaluation of high carbon steel.
6. Metallographic preparation and microstructure evaluation of different cast irons (grey cast iron, white cast iron, malleable cast iron, spheroidal graphite iron).
7. Metallographic preparation and microstructure evaluation of Copper.
8. Metallographic preparation and microstructure evaluation of Brass.
9. Determination of phase fraction and grain size using Image analyzer.
10. Drawing of the Binary phase diagrams of Isomorphous, simple Eutectic and partial solubility diagram with interpretation.
11. Drawing of complex binary phase diagrams and identification of points, lines and areas in them.
12. Experiments to obtain cooling curves for pure metals and alloys and to establish Binary phase diagram.

Course Outcomes:

By completing this laboratory course, students:

1. Can describe the metallurgical microscope, sample preparation, mounting and use/choosing of different etching reagents.
2. Can identify and report the microstructural features of ferrous and non ferrous samples observed.
3. Can operate optical microscope with an ease.
4. Characterize microstructures of engineering alloys using optical microscopy and image analyzer.
5. Prepare formal laboratory reports.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. I-Semester

L	T	P	C
0	0	2	1

METALLURGICAL ANALYSIS LAB

Pre- Requisites: Nil

Course Objectives:

1. This course introduces chemical analysis of metallic alloys using laboratory practice.
2. This course gives knowledge on principles and working of various instruments used in analysis.

List of Experiments:

1. Estimation of Iron in Iron ore by $KMnO_4$ method.
2. Estimation of Iron in Iron ore by $K_2Cr_2O_7$ method.
3. Estimation of lime in Limestone.
4. Estimation of Silicon in Cast Iron.
5. Estimation of manganese in cast iron.
6. Estimation of Sulphur and Phosphorus in cast irons.
7. Estimation of Chromium in Steel.
8. Estimation of Carbon in Steel by Strohlein apparatus method.
9. Estimation of Sodium and Potassium in Chloride Salts by Flame Photometry.
10. Estimation of the concentration of $KMnO_4$ in the solution using Digital Spectrophotometer.

Course Outcomes:

At the end of this laboratory course, the student will be able to:

1. Identify the major elements in a metallic alloy using chemical methods.
2. Quantify specific elements in ferrous and non-ferrous alloys using titration.
3. Interpret the results from different spectroscopy instruments to determine chemical composition.
4. To learn operating techniques of different instruments used in analysis.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. I-Semester

L	T	P	C
2	0	0	0

ENVIRONMENTAL SCIENCE

Pre-Requisites: Nil

Course Objectives:

Course Outcomes:

To be obtained from Other Department.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. II-Semester

L	T	P	C
3	1	0	4

BASIC ELECTRICAL ENGINEERING

Pre- Requisites: Nil

Course Objectives:

1. To introduce the concepts of electrical circuits and its components.
2. To understand magnetic circuits, DC circuits and AC single phase & three phase circuits.
3. To study and understand the different types of DC/AC machines and Transformers.
4. To import the knowledge of various electrical installations.
5. To introduce the concept of power, power factor and its improvement.

UNIT-I

D.C. Circuits :Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.
Time-domain analysis of first-order RL and RC circuits.

UNIT-II

A.C. Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance in series R-L-C circuit.
Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Transformers: Ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT-IV

Electrical Machines: Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT-V

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Text Books:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. S.L. Uppal and G C Garg "Electrical Wiring Estimating & Costing", Khanna Publishers 6th edition, 1987.

Reference Books:

1. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
2. J B Gupta "Electrical Installation Estimating and Costing" S. K. Kataria & Sons, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Course Outcomes:

1. To analyze and solve electrical circuits using network laws and theorems.
2. To understand and analyze basic Electric and Magnetic circuits.
3. To study the working principles of Electrical Machines.
4. To introduce components of Low Voltage Electrical Installations.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

ECONOMICS FOR ENGINEERS

Pre- Requisites: Nil

Course Objectives:

Course Outcomes:

To be obtain from HSMC Department.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. II-Semester

L	T	P	C
3	1	0	4

HEAT TREATMENT AND PHASE TRANSFORMATIONS

Pre-Requisites: Physical Metallurgy.

Course Objectives:

1. This course is mainly designed to impart knowledge about basic principles and process variables of different heat treatment processes.
2. Thermo mechanical treatment, Surface hardening techniques, heat treatment of steels, cast irons, non ferrous alloys will also be in detail.
3. Identification of heat treatment defects and related knowledge of heat treatment furnaces with dealth.

UNIT-I

Principles of Heat Treatment of steels**.** Formation of Austenite on heating, Austenitic grain size, determination and decomposition of austenite. TTT and CCT curves. Effect of alloying elements on TTT curves and Fe-Fe_3C diagram. Phase Transformations: Pearlitic Transformation, Bainitic Transformation, Martensitic Transformation, Order-disorder transformation, Spinodal decomposition.

UNIT-II

Annealing, Normalizing, Hardening and tempering. Mechanism of heat removal during quenching, quenching media, size effect and mass effect. Tempering and its stages, Austempering, Martempering, Subzero treatment, Patenting. Hardenability of steels, Factors affecting and its determination.

UNIT-III

Surface Heat Treatment: Principles and Applications of Carburizing, Nitriding, Carbonitriding, Nitrocarburizing, Boronizing and Aluminizing. Thermal Surface Modification Processes- Flame, Induction and Laser hardening. Thermo mechanical treatments: HTMT, LTMT, Ausforming, Isoforming, Cryoforming.

UNIT–IV

Heat-Treatment of Cast Irons, Cu and its alloys and Al and its alloys.

UNIT-V

Heat treatment furnaces, Atmospheres and their design, Heat treatment defects.

Text Books:

1. Heat Treatment Principle and Techniques - Rajan & Sharma.
2. Phase Transformations in Metals and Alloys - D. A . Porter and K.E. Esterling.

Reference Books:

1. Heat Treatment of Metals by Vijendra Singh
2. Physical Metallurgy – Lakhtin.
3. Physical Metallurgy - Clark and Varney.
4. Physical Metallurgy Principles - Reed Hill.

Course Outcomes:

At the end of the course the student will be able to:

1. Apply and interpret phase and continuous cooling diagrams information to assess the impact of a range of heat treatment procedures.
2. Demonstrate a critical understanding of the importance of heat treatment in achieving the desired results in metals and alloys.
3. Learn the fundamentals of microstructure modifications through thermo mechanical and surface heat treatment processes to achieve the desired properties.
4. Propose suitable heat treatment procedures for non ferrous metals like Copper, Aluminium, etc.
5. Identify the reason the heat treatment defects and explain the various heat treatment furnaces and their atmospheres.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

PRINCIPLES OF EXTRACTIVE METALLURGY

Pre-Requisites: Mineral dressing and Thermodynamics and Kinetics.

Course Objectives:

1. To learn and emphasize the Principles of Pyrometallurgy, hydrometallurgy and electrometallurgy.
2. To learn scientific concepts of extraction and refining.
3. Obtain knowledge of equipment used in Pyrometallurgy, hydrometallurgy and electrometallurgy.
4. Gain basic knowledge about pelletisation and Sintering.

UNIT-I

Introduction: Classification of ores. Basics of Pyrometallurgy, Calcination, Roasting and types of roasting-Oxidising, sulphatising, and chloridizing. Simple equations/reactions. Roasting furnaces: Multiple hearth roaster, flash roasting, fluidized bed roasting and blast roasting.

UNIT-II

Pelletisation and Sintering. Smelting: Principles of reduction and matte smelting with examples. Smelting furnace: Reverberatory, BF and electric smelting. Flash smelting.
Slags: Classification, properties, Application of Ellingham diagrams for oxides and sulphides.

UNIT-III

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

UNIT-IV

Classification of electrometallurgy, Principles of electrometallurgy, Advantages and limitations of electrometallurgy, Electro winning and Electro refining with typical examples.

UNIT-V

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

Text Books:

1. Non-ferrous extractive metallurgy:H.S.Ray, K.P.Abraham and R.Sreedhar.
2. Principles of extractive metallurgy-H.S. Ray & A. Ghosh.

Reference Books:

1. A text book of metallurgy-A.R.Bailey.
2. Principles of extractive metallurgy-A.K. Ghosh.
3. Principles of extractive metallurgy-Terkel Rosenqvist ,Tapir Academic Press, 2004.

Course Outcomes:

At the end of the course the student will be able to:

1. Students will be able to classify the different ores and describe the various units operating like pyro metallurgy, hydrometallurgy and electrometallurgy.
2. Students will be able to differentiate the various types of slags, properties and their applications.
3. Illustrate with the help of flow sheet of process taking place in pyro metallurgy, hydrometallurgy and electrometallurgical extractions of metal/matte.
4. Students will be able to choose the type of refining process according purity required.
5. Students will understand the impact of extractive process on health environment society and will be able to suggest suitable techniques to recycle the byproducts or to decrease energy consumptions.
6. Students will be able to design the suitable process for extraction.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. II-Semester

L	T	P	C
3	1	0	4

METALLURGICAL THERMODYNAMICS

Pre-Requisites: Nil

Course Objectives:

This course is mainly intended to deals with

1. The laws of diffusion.
2. Interpret Ellingham diagrams
3. Identify metallurgical thermodynamics principles to be applied in phase diagrams.

UNIT-I

Diffusion: Fick's laws of diffusion and its applications, Kirkendall effect, Darken's equations, the Matano Method. Determination of intrinsic diffusivities, self diffusion in pure metals, Temperature dependence of the diffusion coefficient, diffusion along the grain boundaries and surfaces.

UNIT-II

Ellingham Diagrams**:** Introduction, calculation of equilibrium constants from standard free energy changes, general description of Ellingham diagrams, Interpretation of free energy changes Vs. temperature lines, Richardson's diagrams.

UNIT-III

Thermal Properties: Specific heats of solids, classical, Einstein and Debye's models of the lattice.
Anharmonicity, thermal expansion, thermal conductivity of solids, lattice thermal conductivity and thermo-electric effects. Stability of crystal disorders.

UNIT-IV

Solutions: Solution definition, Composition, partial molal quantities, ideal solutions, Raoult's Law, actual (Nonideal) solutions, Sievert's law, Gibbs - Duhem equation, integration of Gibbs - Duhem equation, Excess thermodynamics quantities.
Application to phase diagrams: Concept of chemical potential, equality of chemical potentials in equilibrated phases, Derivation of Gibbs phase rule, solidus and liquidus lines for an ideal solution, calculation of liquidus line for eutectic systems.

UNIT-V

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

Text Books:

1. Physical Chemistry for Metallurgist by J. Mackowick.
2. Physical Chemistry of Metals by LS Darken and Gurry.

Reference Books:

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

Course Outcomes:

Obtain the skill to use Metallurgical Thermodynamics concept for

1. Understand and able to use Fick's I and II law.
2. Interpret Ellingham Diagram for oxides.
3. Understand the thermal properties of solids, specifically, specific heat and some models for specific heat calculation.
4. Knowledge of ideal and regular solutions and free energy of mixing.
5. Apply the phase rule on the metallurgical systems.
6. Understanding of the nature of polarized electrochemical reactions and an introduction of their application in corrosion behavior of metals.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. II-Semester

L	T	P	C
0	0	2	1

BASIC ELECTRICAL ENGINEERING LAB

Pre-Requisites: Basic Electrical Engineering

Course Objectives:

1. To analyze a given network by applying various electrical laws and network theorems
2. To know the response of electrical circuits for different excitations
3. To calculate, measure and know the relation between basic electrical parameters.
4. To analyze the performance characteristics of DC and AC electrical machines

List of Experiments/Demonstrations:

1. Verification of Ohms Law.
2. Verification of KVL and KCL.
3. Transient Response of Series RL and RC circuits for DC excitation.
4. Transient Response of RLC Series circuit for DC excitation.
5. Resonance in series RLC circuit.
6. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits.
7. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single Phase Transformer.
8. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation).
9. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star).
10. Measurement of Active and Reactive Power in a balanced Three-phase circuit.
11. Performance Characteristics of a Separately/Self Excited DC Shunt/Compound Motor.
12. Torque-Speed Characteristics of a Separately/Self Excited DC Shunt/Compound Motor.
13. Performance Characteristics of a Three-phase Induction Motor.
14. Torque-Speed Characteristics of a Three-phase Induction Motor.
15. No-Load Characteristics of a Three-phase Alternator.

- Any ten experiments will be conducted from the above list

Course Outcomes:

1. Get an exposure to basic electrical laws.
2. Understand the response of different types of electrical circuits to different excitations.
3. Understand the measurement, calculation and relation between the basic electrical parameters
4. Understand the basic characteristics of transformers and electrical machines.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. II-Semester

L	T	P	C
0	0	2	1

PRINCIPLES OF EXTRACTIVE METALLURGY LAB

Pre-Requisites: Principles of extractive metallurgy.

Course Objectives:

1. This is course is design to give knowledge about different types of extraction processes.
2. Know the Importance of EMF series.

List of Experiments

1. Important flow sheets for Metal Extraction.
2. Electro Cleaning of a given material by using electrolysis principle.
3. Electro Etching of a given material by using electrolytic cell.
4. Electro polishing of a given material by using electrolytic cell.
5. Importance of EMF series.
6. Calculate cathode current efficiency electro plating of Copper.
7. Calculate cathode current efficiency electroplating of Nickel.
8. Galvanization of Zinc on mild steel.
9. Electro winning of Copper by using aqueous electrolyte.
10. Electro winning of Copper by using prepared electrolyte from raw materials.

Course Outcomes:

1. To study the importance of EMF series.
2. Understand different types of electro cleaning techniques.
3. Study the concepts of metal extraction process.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Met. Engg. II-Semester

L	T	P	C
0	0	2	1

HEAT TREATMENT AND PHASE TRANSFORMATIONS LAB

Pre-Requisites: Heat treatment and Phase transformations.

Course Objectives:

This course is mainly designed to

1. To conduct various heat treatment processes, surface hardening techniques and age hardening processes on different materials.
2. Gain knowledge of phase transformations taking place under various conditions of heat treatment.

List of Experiments:

1. Annealing of plain carbon steel and observation of microstructure.
2. Normalizing of plain carbon steel and observation of microstructure.
3. Hardening of plain carbon steel with quenching in water and brine solution and observation of microstructures.
4. Hardening of plain carbon steel with quenching in oil and observation of microstructure.
5. Effect of tempering temperature on plain carbon steel.
6. Effect of tempering time on plain carbon steel.
7. Age hardening of Aluminium alloy or Copper alloy.
8. Spheroidizing of a given high carbon steel.
9. Surface hardening of plain carbon steel.
10. Determination of hardenability of medium carbon steel by Jominy end quench test.
11. Determination of phase fraction and grain size using Image analyzer.

Course Outcomes:

At the end of the course the student will be able to:

1. Conduct heat treatment in furnaces under suitable/ required time, temperature and atmospheric conditions.
2. Modify the microstructures of metals and alloys through heat treatment practice for obtaining desired properties in present and future.
3. Analyze, correlate and interpret the results obtained in the tests conducted.
4. Report the observations in a formal manner.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I -Semester

L	T	P	C
3	0	0	3

INTRODUCTION TO INDUSTRIAL MANAGEMENT

Pre requisites: Nil

Course Objectives:

Course Outcomes:

To be obtained from HSMC Department.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

FUELS, FURNACES & REFRACTORIES
(Professional Elective – I)

Pre-Requisites: Nil.

Course Objectives:

1. Relate the properties and applications of solid, liquid and gaseous fuels.
2. Broad knowledge of modes of heat transfer.
3. Describe the different types of refractories and pyrometers and their properties and uses.
4. Have a basic knowledge of working of different types of furnaces.

UNIT–I

Introduction to Fuels technology: Classification of fuels, Origin and classification of coal, Proximate and ultimate analysis of coal and its applications. Properties and uses of Pulverized coal, Carbonization of coal and types of Carbonization. Properties, uses and testing of Metallurgical Coke.
Liquid fuels: Properties and applications.

UNIT –II

Manufacture, properties and uses of Producer gas and Water gas.
Modes of heat transfer, Importance of heat transfer. Steady State Heat Transfer: Conduction through plane, cylindrical, Spherical and compound walls, shape factor and effect of variable thermal conductivity. Dimensional groups. Free and forced convection. Heat transfer by combined effect of conduction and convection between two fluids separated by a plane wall and cylindrical wall.

UNIT-III

Furnaces: Classification and uses of furnaces, characteristic features of vertical shaft furnaces, reverberatory furnaces, Arc and Induction furnaces. Tube and muffle type resistance furnaces, continuous furnaces. Heat losses in furnaces and heat balance. Waste heat utilization methods: Simple working of recuperators and regenerators.

UNIT-IV

Pyrometry: Thermo electric pyrometer - Peltier and Thomson e.m.f. Thermo-electric power of thermocouples. Required properties of thermocouples. Noble and base metal thermocouples. Thermo-pile. Measurement of e.m.f. by Milli-voltmeter and potentiometer.
Principle, operation and applications of Thermometer, Optical and Radiation pyrometers.

UNIT – V

Refractories: Classification and desirable properties of refractories, modes of failure of refractories in service and their prevention. Manufacturing methods and properties of Fireclay, Silica, Magnesite, Dolomite, Chromite and Carbon refractories. Testing of Refractories, Applications of refractories in the metallurgical industries.

Text Books:

1. Fuels, Furnaces and Refractories – O.P.Gupta, Khanna Publishers.
2. Metallurgical furnaces – Krivadan and Markov.

Reference Books:

1. Elements of fuel technology – HIMUS.
2. Furnaces -J. D. Gilchrist.
3. Pyrometry -W.P. wood& J. M. Corck.
4. Elements of heat transfer - Jakob & Hawikns.
5. Elements of thermodynamics& heat transfer - Obert & Young.
6. Control systems & Instrumentation – S. Bhasker.

Course Outcomes:

At the end of the course the student would be able to:

1. Know about a fuel, classify them and compare different types of fuels and describe their testing methods. Explain the coke making process, list out the properties and its by-products recovery and suggest methods for decreasing environmental pollution and energy consumption.
2. Apply principles of heat and mass transfer to basic engineering systems and understand the basic concepts and laws of the three modes of heat transfer and apply analytical techniques to the solution of conduction heat-transfer problems.
3. Classify and explain construction and working of different furnaces. Analyze the causes of heat losses in furnaces and suggest methods of minimization it and waste heat recovery.
4. Describe the operation of a thermocouple. Describe various temperature-measuring devices and thermometers and pyrometers. Discuss the principles that govern noncontact thermal measurements and describe the operation of optical and radiation pyrometers.
5. Explain various manufacturing and testing processes of refractories. Itemize many examples of metallurgical refractories under different categories, their main properties and applications. Link inherent properties of the refractory mineral and how it affects the production technology and the application.
6. Select the relevant fuel, furnace and refractory material for the metallurgical operations and can justify the interpretation.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

NANO MATERIALS
(Professional Elective – I)

Pre-Requisites: Physics and chemistry.

Course Objectives:

1. This course is primarily intended to expose the students to a highly interdisciplinary subject.
2. This would emphasize on the classification, synthesis and applications of Nano materials.
3. To enhance the various nano synthesis techniques and to identify and solve problems.
4. To describe methods for production of nano materials and their characterization techniques for application of nano materials.

UNIT-I

Introduction, Importance of Nano-technology, Emergence of Nano-Technology, Bottom-up and Top-down approaches, challenges in Nano Technology.

UNIT-II

Zero Dimensional Nano-structures, Nano particles through homogenous nucleation; Growth of nuclei, synthesis of metallic Nano particles, Nano particles through heterogeneous nucleation; Fundamentals of heterogeneous nucleation and synthesis of nano particles using micro emulsions and Aerosol.

UNIT-III

One Dimensional Nano-structures, Nano wires and nano rods, Spontaneous growth: Evaporation and condensation growth, vapor-liquid-solid growth, stress induced recrystallization.

Template based synthesis: Electrochemical deposition, Electro-phoretic deposition. Electro-spinning and Lithography.

UNIT-IV

Two dimensional Nano-Structures, Fundamentals of film growth. Physical vapour Deposition(PVD): Evaporation molecular beam epitaxy (MBE), Sputtering, Comparison of Evaporation and sputtering.

Chemical Vapour Deposition (CVD): Typical chemical reactions, Reaction kinetics, transportant phenomena, CVD methods, diamond films by CVD.

UNIT-V

Thin films, Atomic layer deposition (ALD), Electrochemical deposition (ECD), Sol-Gel films.

Special Nano Materials, Carbon fullerene and nano tubes: carbon fullerenes, formation, properties and applications. Carbon nano tubes: formation and applications.

Text Books:

1. Nano Materials: A. K. Bandyopadyay, New age Publications.
2. Nano Essentials: T. Pradeep, TMH.

Reference Books:

1. Springer Handbook of Nanotechnology.
2. The Guest for new materials Auther S. T. Lakshmi Kumar, Published by Vigyan Prasar.
3. Nano – The Essentials: C – Pradeep (IIcue Professor), McGraw Hill.
4. Nano Materials Synthesis, Properties and applications, 1996, Edlstein and Cammarate.

Course Outcomes:

1. Understand and describe the importance and impact of nanoscale science which has to the engineering of materials and processes for the 21st century. Use fundamental knowledge in materials science to solve problems associated with nanomaterials and nanotechnology.
2. Understand and describe the latest development of the nanomaterials in commercial and industrial applications. Apply the basic principle of nanomaterials science and engineering, that microstructure controls properties and processing controls microstructure.
3. Identify the scientific issues that underpin the nanoscale properties of materials, nanotechnology in nature and nanoscale measurement and analysis. Describe the different chemical and physical behaviours of nanomaterials.
4. Evaluate the role of standards with respect to nanomaterial performance. Use technical terms relating to nanomaterials science and engineering. Solve simple nanomaterials selection problems and critically assess nanomaterials selection procedures.
5. Understand and apply methodologies and techniques of synthesis, processing and characterization of major classes of nanomaterials. Recognize major application areas of nanomaterials and nanotechnologies in contemporary world and be able to generate creative solutions for different applications.
6. Demonstrate the capacity for self-directed learning on topics related to nanoscience and nanotechnology.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

COMPUTATIONAL MATERIALS ENGINEERING
(Professional Elective – I)

Pre-Requisites: Nil

Course objective:

1. This course introduces computational methods in the domain of metallurgical engineering.
2. To understand the structure property correlations in materials engineering.
3. To understand evolution of materials structure and to control material properties.
4. To calculate the miscellaneous problems by using computational techniques.

UNIT- I

Introduction, **Tools of the trade: a short tutorial introduction:** The C programming language, GNU plot – the plotting freeware, GNU Octave for computations and plotting, Introduction to FEM, FDM, FVM and Computer packages: MATLAB, Sci Lab. Plotting, Fitting, Interpolation, Numerical integration, Numerical differentiation.

UNIT-II

Structure and Thermodynamics: Basics of Mathematical Modelling-Deterministic and stochastic / probabilistic models. Structure and defects. Computing free energy of common metallurgical systems from enthalpy and entropy or heat capacity and determination of temperature of reduction of metal oxides. Regular solution model.

UNIT- III

Phase Transformations; Mathematical formulation of Solid state processes of Heat treatment & Microstructure evolution, Diffusion and precipitate growth kinetics. Transport phenomena based Modelling: model formulation based on heat, mass and momentum transfer, governing equations and boundary conditions. Spinodal decomposition, Classical Molecular Dynamics Modelling and simulations and its applications in materials, Monte Carlo simulations: phase separation and ordering.

UNIT-IV

Phase-Field and Heat-Mass Transfer; Mathematical formulation of Liquid state Metallurgical Processes of Iron Making, Primary Steel Making and Secondary Steel Making using Momentum, Mass and Energy Balance. Principles of Computational Fluid flow and setting up the governing equation with boundary conditions. Formulation of Laminar and Turbulent flows. Case Studies of Tapping of Liquid steel, melting behaviour of additions, IGP. Computation of % CO/CO_2 at different heights with a given function of temperature profile along the height of BF and Simulations of Blast furnace reduction reactions at various heights. Mathematical Modeling of Solidification of Steel in Sand Moulds, Ingot Moulds & Concast.

UNIT-V

New approach; Optimization and control. Elements of modern artificial intelligence (AI) related techniques. Introduction to Genetic Algorithm and Artificial Neural Nets. Dis-critized Methods of Taylor's series expansion, polynomial Interpolation and least square approximation for numerical computation of Non linear algebraic equations, ODE & PDE. Statistical methods for validating models.

Text Books:

1. Introduction to Computational Materials Science – Richard LeSar, Cambridge University Press (2013).
2. Applied numerical methods for engineering using matlab and C – R.J. Schilling and S.L. Harris, Cengage Learning (2007).

Reference Books:

1. Mathematical Methods for Physics and Engineering, 3rd Edition – R.F. Riley, M.P. Hobson, S.J. Bence, Cambridge University Press (2012).
2. Modeling in materials processing – J.A. Dantzig and C.L. Tucker III, Cambridge University Press (2001).
3. V Raghavan, "Materials Science and Engineering", Prentice-Hall India, 2004.
4. E Kreyzig, "Advanced Engineering Mathematics", Wiley-India,1999.
5. Dipak Mazumdar, James W. Evans, "Modelling of Steel Making Processes", CRC Publication,1st Edition, 2010.
6. H.K.Versteeg , W.Malalsekera, "An Introduction to Computational Fluid Dynamics", Longman Scientific and Technical, 1st Edition 1995.
7. S.C.Chapra, R.P.Canale, "Numerical Methods for Engineers", McGraw Hill India Pvt. Ltd.,5th Edition, 2002.
8. S. Yip (Ed.): Handbook of Materials Modelling, Springer, 2005.
9. Santosh K. Gupta: Numerical Methods for Engineers, New Age International (P) Limited, New Delhi, 1998.

Course Outcomes:

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

1. Analyse a metallurgical problem to create a well posed numerical problem.
2. Identify initial and boundary conditions of a problem relevant to materials domain.
3. Propose a solution procedure for a numerical problem in the domain of materials engineering.
4. Demonstrate ability to quantify a materials engineering problem through numerical analysis.
5. Select materials for specific applications and also to design advanced materials for new applications.
6. To use preferred tools at electronic, continuum and structural levels.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I-Semester

L	T	P	C
4	0	0	4

MECHANICAL METALLURGY

Pre-Requisites: Physical Metallurgy and Heat-treatment.

Course Objectives:

1. To gain and understanding of the response of various metals under the application of stress and/or temperature.
2. To build necessary theoretical back ground of the role of lattice defects in governing both elastic and plastic properties of metals will be discussed.
3. Obtain a working knowledge of various hardness testing machines BHN, VHN, RHN.
4. Obtain a working knowledge of creep and fatigue and analysis of data.

UNIT-I

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

UNIT–II

Hardness Test: Methods of hardness testing – Brinell, Vickers, Rockwell, Shore and Poldi methods, Microhardness test, relationship between hardness and other mechanical properties.

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

UNIT-III

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

Fracture: Elementary theories of fracture, Griffith's theory of brittle fracture, Ductile Fracture, Notch sensitivity. Strain-Energy Release Rate, Stress Intensity Factor, Fracture Toughness and Design, K_{IC} Plane-Strain Toughness Testing, Plasticity Corrections, J-Integral.

UNIT–IV

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

UNIT–V

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

Text Books:

1. Mechanical Metallurgy – G. E. Dieter.
2. Engineering Materials Science – C. W. Richards.

Reference Books:

1. Mechanical behavior of material - A. H.Courteny.
2. Mechanical behavior - Ed. Wulf.
3. Mechanical Metallurgy – White & Lemay.

Course Outcomes:

At the end of the course the student will be able to:

1. Interpret the effect of crystalline defects on the behaviour of metals.
2. Can conduct Hardness, Impact test and interpret COD, CTOD, DBTT diagrams.
3. Determine the appropriate test to be conducted for analysis of tensile and compression properties of materials.
4. Can design fracture and fatigue resistant materials.
5. Assess and describe the mechanism leading to failures of a given material.
6. Knowledge of how to incorporate material strength limitation into engineering design.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I-Semester

L	T	P	C
4	0	0	4

IRON MAKING AND STEEL MAKING TECHNOLOGIES

Pre-Requisites: Mineral Dressing, Principles of Extractive Metallurgy and Thermodynamics.

Course Objectives:

1. To provide the knowledge of Iron making by Blast Furnace, Physio- chemical principles involved in iron making.
2. To understand and demonstrate the various types of steel making processes, Hot metal route and scrap route.
3. Able to model, optimize and control various reactors involved in steel plant supply chain.
4. To apply the principles of physical chemistry and transport phenomena to process steps in iron and steel making.

UNIT-I

Raw materials for Iron making, Preparation of iron ores; Agglomeration of Iron ore fines: Sintering - Purpose and Principle, Factors affecting sintering, sintering bonds; Pelletisation - Purpose and Principle, Production of green pellets, Induration of pellets.

UNIT-II

Iron making through blast furnace route, Blast Furnace profile and its design, refractory lining, blast furnace cooling system, raw materials handling and charging. Construction and operation of Hot blast stoves. Gas cleaning system and its utilization.

UNIT-III

Physical chemistry of Iron making, Blast furnace reactions, Physical and chemical factors affecting reduction of ores; Effect of temperature, CO/CO_2 and H_2/H_2O on reduction of iron ore. Control of C, Si, S, P in pig iron. Blast furnace operations and difficulties, modern trends in blast furnace.

UNIT-IV

Classification and raw materials of steel making. Principles of Steel making, Removal of carbon, silicon, manganese, phosphorous and sulphur. Role of slag, types and properties of slags. Principles and types of deoxidation.

UNIT-V

Steel making by Bessemer, Open Hearth and Electric arc furnace processes. Basic oxygen steel making: LD, LDAC, Kaldo, and Rotor oxygen steel making. Hybrid process of steel making LD-KG, CLU, MRP. Ingot casting (Conventional casting).

Text Books:

1. A first course in iron and steel making, Dipak Mazumdar, Orient Blackswan Pvt. Ltd., (2015).
2. Iron making and steelmaking: Theory and Practice, Ghosh Ahindra, Chatterjee Amit, PHI Learning Private Limited, (2001).

Reference Books:

1. Basic Thermodynamics and Kinetics, Alain Vignes (ISTE Ltd.,).
2. Metallurgical Reaction Processes, Alain Vignes (ISTE Ltd.,).
3. Processing Operations and Routes, Alain Vignes (ISTE Ltd.,).
4. An introduction to modern steel making, R. H. Tupkary, Khanna Publishers (2000).
5. An introduction to modern iron making, R. H. Tupkary, Khanna Publishers (2004).

Course Outcomes:

At the end of this course the student will be able to:

1. Describe the raw materials and agglomeration techniques production of iron.
2. Describe the blast furnace and its auxiliary equipments.
3. Analyze the physical and chemical processes taking place in blast furnace and factors influencing the quality of the blast furnace product.
4. Analyze the irregularities and causes of failures in blast furnace and apply remedial measures for immediate rectification.
5. Describe the principles of steel making process and various processing techniques for quality steel making.
6. Know the conventional/ingot casting practice in steel making and its auxiliary units and their importance.
7. Judge what casting procedure should be followed for obtaining a quality product.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I-Semester

L	T	P	C
4	0	0	4

MATERIALS PROCESSING – I

Pre-Requisites: Nil

Course Objectives:

1. This course is mainly intended to introduce and explain various moulding, casting techniques and equipment used.
2. Principles of Solidification of casting, defects in castings and their remedies are also dealt in detail.
3. This course also provides in depth knowledge about various metal joining techniques, the thermal and residual stresses associated with, the equipment used, their modern developments, and defects of weldments.

UNIT- I

Introduction to Foundry – Types of Foundries, Patterns: Materials for patterns, types of patterns; functions and pattern allowance. Moulding materials; moulding sands, properties and selection of materials and additives.

Moulding Processes : Green and dry sand moulding; shell moulding, CO_2 moulding. Core making. Gating, Risering and their design.

UNIT-II

Casting Methods: Permanent mould casting, pressure die-casting, Gravity die casting, Vacuum die casting, centrifugal casting, Investment Casting, Squeeze casting and Composite Casting, Casting defects arising due to moulding, cores, melting and pouring practice.

UNIT- III

Melting and Solidification: Cupola and Induction Melting. Progressive and Directional Solidification. Classification of welding processes: Principles, advantages disadvantages and fields of application of the following welding processes: Gas Welding, Arc Welding processes, MMAW, GTAW, MIG, SAW and Resistance Welding

UNIT- IV

Metal Joining Techniques: Principles, advantages disadvantages of Thermit welding, Electron Beam Welding, Laser welding, Solid state welding, Friction stir welding processes, Ultrasonic welding, Explosive welding.

UNIT-V

Microstructure of fusion zone and heat affected zone. Influence of heat input, thermal and residual stresses, pre heat and cooling rate, PWHT.Problems during welding of carbon steels and Remedies, Welding Defects.

Text Books:

1. Principles of Metal casting by Heine – Loper and Rosenthal, Tata McGraw Hill, 2nd Edition.
2. Welding Technology – O.P. Khanna.

Reference Books:

1. Metals Handbook Vol. 5 published by ASM, Ohio.
2. Foundry Technology – Dharmendra Kumar & S.K.Jain, CBS Publisher, 2007.
3. Manufacturing Technology – Vol. I: Foundry, Forming and Welding, P.N.Rao, McGraw Hill 3rd Edition.
4. Casting Technology and Cast Alloys – AK Chakrabarti – PHI 2011 Edition.
5. Castings – John Campbell – Second Edition – Elsevier.
6. Welding Metallurgy - JF Lancaster.
7. Welding and Welding Technology – Little.

Course Outcomes:

1. Determine moulding sand dry, hot and green strength.
2. Understand the preparation of moulding sand.
3. Determine moulding sand properties by varying additives.
4. Understand the Melting of Al alloys.
5. Gain hands on experience in various methods of welding and joining of metals and understand the mechanical behavior of the joint with respect to microstructure and mechanical properties.
6. Understand the causes of welding defects and how they can be prevented.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I-Semester

L	T	P	C
0	0	3	1.5

MECHANICAL METALLURGY LAB

Pre-Requisites: Mechanical Metallurgy.

Course Objectives:

Students will be able:

1. Demonstrate skill in using different hardness testing machines.
2. Explain the rationale for using particular loads in testing hardness and tensile properties of materials.
3. Use the standard specimens in determining toughness and ductility of materials.
4. Become aware of working principle and use of various Non Destructive Tests.

List of Experiments:

1. Determine the hardness of ferrous and non-ferrous samples using Brinell hardness.
2. Determine the hardness of ferrous and non-ferrous samples using Rockwell hardness.
3. Tension test:
    a. Determine the Tensile properties of ductile ferrous materials.
    b. Determine the Tensile properties of ductile non-ferrous materials.
4. Determine the Compression properties of brittle materials.
5. To determine the Toughness of the given material by Charpy and Izod (V & U Groove notch).
6. Determination the variation of ductility of the given various thickness materials by Erichson cupping test.
7. Liquid penetrant Test: To detect the surface flaws in a given materials by die penetrant.
8. To detect the surface flaws in steel by fluorescent penetrant method.
9. Magnetic flaw detector: To inspect a given material for cracks.
10. Ultrasonic flaw detection: To inspect a given material for locating cracks.

Course Outcomes:

After completing the course, the student will be able:

1. Explain the methods of destructive testing (Hardness testing, Tensile testing, Impact and cupping tests) and non destructive testing (LPT, MPT and UT).
2. Analyze, interpret and present the observation from the tests conducted.
3. Identify the reasons for failure through Non Destructive Examination.
4. Can prepare formal laboratory reports describing the experimental and the results obtained.
5. Solve material problems associated with testing.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I-Semester

L	T	P	C
0	0	3	1.5

MATERIALS PROCESSING LAB - I

Pre-Requisites: Nil

Course Objectives:

1. This lab course is designed to provide hands on experience on various foundry testing methods for evaluation of moulding sand properties.
2. It also designed to make the student to understand and demonstrate the various types of welding processes and its variables.
3. Understand and apply the principles of metal casting process and develop relation between input and output parameters.
4. To study the various modes of metal transfer that exists in welding processes.

List of Experiments:

1. Preparation of gating system using green sand moulding.
2. Study of particle size distribution of the sand.
3. Study of permeability of green sand with clay and water.
4. Determination of sand properties: green and dry strength, green and dry hardness, hot shear strength with variation in sand additives.
5. Determination of clay content in sand.
6. Determination of moisture content in sand.
7. Determination of the shatter index of green sand.
8. Melting of Al alloys in a pit furnace and casting into light components.
9. Preparation of a butt joint with mild steel plates using Arc welding process and study the comparison of the bead geometry with DCSP, DCRP and A.C.
10. Demonstration and practice of resistance spot welding process and plot the variation of spot area with time and current variation.
11. Preparation of a butt joint with mild steel strip using Tungsten Inert Gas (TIG) welding process.
12. Preparation of a butt joint with mild steel plate using MIG welding process.
13. Evaluation of Microstructure of welded joint and observe the structural difference in Weld zone, Heat Affected Zone and Base metal.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Determine moulding sand dry, hot and green strength.
2. Understand the preparation of moulding sand.
3. Determine moulding sand properties by varying additives.
4. Understand the Melting of Al alloys.
5. Gain hands on experience in various methods of welding and joining of metals and understand the mechanical behaviour of the joint with respect to microstructure and mechanical properties.
6. Understand the causes of welding defects and how they can be prevented.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. I-Semester

L	T	P	C
0	0	2	1

FUELS LAB

Pre-Requisites: Fuels, Furnaces and Refractories theory.

Course Objectives:
This laboratory course deals with:
1. Analysis of fuels.
2. Characterization of solid fuels , liquid fuels and refractories.
3. Use different types of fuel testing equipment.

List of Experiments:
1. Proximate analysis of Coal (percentage of moisture, volatile matter, ash content).
2. Ultimate analysis of Coal (Carbon, hydrogen, sulfur and oxygen).
3. Determination of Flash and Fire points of diesel using PENSKY MARTINS open and closed cup apparatus.
4. Determination of Flash and Fire points of kerosene using PENSKY MARTINS open and closed cup apparatus.
5. Determination of Flash and Fire points of diesel using ABEL's apparatus.
6. Determination of Flash and Fire points of kerosene using ABEL's apparatus.
7. Determine the effect of kinematic viscosity of lubricant oil by using Red-wood Viscometer-I.
8. Determine the effect of kinematic viscosity of lubricant oil by using Red-wood Viscometer-II.
9. Determine the calorific value of coal by using "Bomb Calorimeter".
10. Determination of apparent density of refractories.
11. Determine the calorific value of gaseous fuels by using "Junker's Gas Calorimeter".

Course Outcomes:
At the end of the course the student would be able to:
1. Gain hands-on experience on the equipment that facilitate property evaluation of fuels, and refractories.
2. Choose the fuels and refractories for specific use in construction and operation of different furnaces.
3. Able to select fuels, refractories to minimize overall cost of production for given applications.
4. Operate various types of fuel testing equipment and analyze the observations recorded.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

ENGINEERING MATERIALS
(Open Elective - I)

Pre-Requisites: Nil.

Course Objectives:

1. To gain knowledge about the uses and application of various ferrous metals and alloys.
2. To gain knowledge about the uses and application of various non ferrous alloys.
3. To gain knowledge about the uses and application of various ceramics, polymers and composites for different engineering applications.

UNIT-I

Ferrous Alloys: Introduction, Designations and classifications, Properties and applications of Carbon Steels: Low, medium and high carbon steels, Stainless steels and Cast Irons

UNIT-II

Nonferrous Alloys: Introduction, properties and applications of Aluminum Alloys, Magnesium Alloys, Copper Alloys and Titanium Alloys.

UNIT-III

Ceramic Materials: Introduction, Properties and Applications of Ceramics, Glasses and Refractories.

UNIT-IV

Polymers: Introduction, Classification, Properties and Applications of Polymers, Polymerization, Degree of Polymerization, Typical Thermoplastics and Thermosets.

UNIT-V

Composites: Introduction, Classification, Properties and Applications of Polymer matrix, Metal Matrix Ceramic Matrix and Laminar composites.

Text Books:

1. W.F.Smith, Principles of Materials Science and Engineering, Mc Graw Hill, New York, 1994.
2. William D. Callister Introduction to Material Science and Engineering, John Wiley and Sons, 2007.

Reference Books:

1. Donald R. Askland, Pradeep P. Phule, The Science and Engineering of Materials (4th Edition), Thomson Publishers, 2003.
2. Engineering materials- R.K. Rajput.
3. Engineering materials - Michael F. Ashby and David R.H.Jones.

Course Outcomes:

At the end of the course, student would be able to recommend

1. At the end of the course the student will be able to understand the importance of ferrous alloys and their classification and apply the knowledge of heat treatment and analyze the effect of alloying elements.
2. Describe the properties of NFA and choose a particular alloy for a given application.
3. Correlate the structure, property and applications of ceramics and polymers.
4. Understand the importance of composite and select a particular composite for a given application.
5. Able to analyze the properties of different metallic and non metallic materials and justify their choice.
6. Able to gain knowledge on different non- ferrous alloys for a given engineering applications and service conditions.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

METALLURGY FOR NON METALLURGISTS
(Open Elective - I)

Pre-Requisites: Nil.

Course Objectives:

1. To describe the basic principles of metallurgy and the importance of metallurgy in various disciplines of engineering.
2. Gain thorough knowledge about heat treatment of steels.
3. Gain knowledge about properties and uses of cast irons and non ferrous metals.
4. Gain working knowledge of basic testing methods for metals.

UNIT-I

Introduction: Crystal structure and defects, Crystal structure of metals, Classification of steels, Carbon steels.

UNIT-II

Heat Treatment of Steels: The Iron carbon systems, Common phases in steels, Annealing, Normalizing, Hardening and tempering.

UNIT-III

Cast irons: Properties and applications of Ductile irons, Malleable irons, Compacted graphite iron.

UNIT-IV

Non Ferrous Metals: Properties and applications of Light Metals (Al, Be, Mg, Ti), Super alloys.

UNIT-V

Testing of Metals: Hardness testing, Tensile Testing, Impact Testing, Fatigue Testing.

Text Books:

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL ,1997.

Reference Books:

1. Engineering Physical Metallurgy and Heat treatment – Y Lakhtin
2. C. Suryanarayana, Experimental Techniques in Mechanics and Materials, John Wiley, John Wiley, NJ, USA,2006.
3. Foundations of Materials Science and Engineering – WF Smith.
4. Metallurgy for Engineers- Clark and Varney.
5. Mechanical Metallurgy – G. E. Dieter.

Course Outcomes:

At the end of the course Student would be able:

1. Classify steels and understand the different crystal structures of metals and defects.
2. Establish heat treatment process – structure – properties correlation.
3. Know the metallurgical and mechanical properties of various cast iron and their applications.
4. Justify the choice of light metals and super alloys based on their properties.
5. Evaluate the various mechanical properties in materials by different methods.
6. Able to understand the areas and domains of metallurgy and materials.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
3	1	0	4

NON-FERROUS EXTRACTIVE METALLURGY

Pre-Requisites: Mineral Dressing, Principles of Extractive Metallurgy.

Course Objectives:

1. To explain the various methods of extraction of non ferrous metals.
2. To draw the flow sheets for extraction of various non ferrous metals.
3. To describe the procedure and equipment used for production of non ferrous metals from their ores.

UNIT-I

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

UNIT-II

Zinc: General Principles: Horizontal and vertical retort processes, Production in a Blast furnace, Leaching purification, Electrolysis, Refining.

Lead: Blast furnace smelting, Refining of lead bullion.

UNIT-III

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

UNIT-IV

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

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

UNIT-V

Uranium: Acid and alkali processes for digestion of uranium ores, Purification of crude salt, Production of reactor grade UO_2 and uranium.

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

Text Books:

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

Reference Books:

1. Rare Metals Hand book - C.A. Hampel.
2. Nuclear Reactor General Metallurgy - N. Sevryukov, B. Kuzmin and Y. Chelishchevr.
3. Nuclear Chemical Engineering - Manstion Bendict and Thomas H. Pigfort.

Course Outcomes:

At the end of the course, student would be able to recommend:

1. Get detailed information about the properties of non ferrous metals, ores of non ferrous metals, pre treatment processes, thermodynamics and kinetics involved in extraction process.
2. Describe and explain ore treatment techniques and learn the fundamental concepts of metallurgical pre-treatment methods, production of metals from ore, concentrate and secondary sources.
3. Emphasize the strategic importance of raw and supplementary materials in the production, and explain the concepts of technological and economical feasibility.
4. Identify the beneficiation of by products materialize during the metal production, within the framework of technology-environment-ecology.
5. Explain processes based on an advanced thermodynamic perspective and explain material and energy flows related to extraction of metals and alloys.
6. Understand about Extractive metallurgy processes and explain their relative merits and demerits and also conduct a detailed and individual research about production of a specific metal, as part of their responsibility.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
4	0	0	4

MATERIALS PROCESSING - II

Pre-Requisites: Nil

Course Objectives:

1. To familiarize the students about stress and strain relationship under various conditions.
2. To give the students a back ground of fundamentals of metal working processes.
3. Analyze the behavior of metals during plastic deformation.

UNIT-I

Stress and Strain Relationship for Elastic Behavior: Description of stress at a point. State of stress in two dimensions. Mohr's circle of stress in two dimensions, state of stress in three dimensions. Mohr's circle of stress in three dimensions, Description of strain at point.

Elements of Theory of Plasticity: The flow curve. True stress and true strain. Von-Mises distortion energy criterion, maximum shear stress or Tresca criterion. Octahedral shear stress and shear strain. Basics of the theories of plasticity.

UNIT-II

Fundamentals of Metal Working: Classification of forming processes, Mechanics of metal working for slab method and uniform deformation energy method. Cold working, Recovery, recrystallization and grain growth, hot working, Strain-Rate effects, Work of plastic deformation.

UNIT-III

Forging: Classification of forging processes, forging equipment. Forging in plane strain. Open-die forging, closed-die forging, Forging of a cylinder in plane-strain, forging defects.

Extrusion: Classification of extrusion processes, extrusion equipment. Hot extrusion. Deformation and defects in extrusion. Analysis of the extrusion process. Cold extrusion. Extrusion of tubing and production of seamless pipe and tubing.

UNIT-IV

Rolling of Metals: Classification of rolling process, rolling mills, hot rolling, cold rolling, rolling of bars and shapes, forging and geometrical relationships in rolling. Simplified analysis of rolling load, rolling variables, problems and defects in rolled products. Theories of hot rolling, torque and horsepower, theories of cold rolling, torque and horsepower.

UNIT-V

Drawing of Rods, Wires and Tubes: rod and wire drawing, tube drawing processes, deep drawing and residual stresses in rod, wire and tubes.

Sheet metal forming: Processes and Equipment.

Text Books:

1. Mechanical Metallurgy by GE Dieter (3rd edition).
2. Mechanical working of metals - Avitzone.

Reference Books:

1. Engineering Metallurgy – Part-II – Higgins.
2. Mechanical behavior - Ed. Wulf.
3. Mechanical Metallurgy – White & Lemay.

Course Outcomes:

At the end of the course the student will be able to:

1. Use the Mohr's circle to graphically analyze stresses and strains.
2. Compare and classify different forming processes.
3. Analyze the behaviour of materials during forming processes.
4. Determine forming processes controlling parameters.
5. Estimate required forming loads, powers of different forming equipment and processes.
6. Determine the cause of the defects that may take place during forming processes.
7. Integrate knowledge gained in this course to select and design a complete metal forming system.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
4	0	0	4

ENVIRONMENTAL DEGRADATION OF MATERIALS

Pre-Requisites: Engineering chemistry, Thermodynamics and kinetics and Principles of Extractive metallurgy.

Course Objectives:

1. Electrometallurgy principles in deposition winning and the efficiency of the bath to be discussed.
2. Testing methods are to be studied. Various ways in which corrosion takes place in metals/alloys together with corrosion protection methods and tests conducted are to be studied.
3. Able to use principles to understand, the prevention of corrosion.

UNIT-I

Electro chemical principles, thermodynamic aspects of electrochemical cells, Nernst equation, electrolysis, electrode potentials. Faradays laws, electroplating, electro winning.

UNIT-II

Electrochemical reactions, Polarization, passivity, environmental effects(oxygen, oxidizers, velocity, temperature, corrosive concentration, Galvanic coupling). Corrosion: Introduction, Definition and classification.

UNIT - III

Forms of corrosion, uniform corrosion, Two metal corrosion: Sacrificial anode, EMF and Galvanic Series, Environmental effects, Pitting corrosion, Crevice corrosion. Intergranular corrosion: Sensitization, weld decay, Knife-Line attack, Stress corrosion cracking: crack morphology, stress effects, environmental factors, metallurgical factors, Erosion corrosion: cavitation damage, fretting corrosion, Corrosion fatigue.

UNIT - IV

Corrosion prevention methods: Alteration of Environment (Inhibitors), Design, Coatings, cathodic and anodic protection. Material selection, Metallurgical aspects, Hydrogen damage (hydrogen blistering, Hydrogen embrittlement, Prevention).

UNIT - V

Modern theory and applications of corrosion: Introduction, free energy, cell potentials, emf series, applications of thermodynamics to corrosion, Corrosion rate expressions and measurements, corrosion testing.

Text Books:

1. Corrosion Engineering – Fontana.
2. Electrometallurgy- Blum.

Reference Books:

1. Introduction to Electrometallurgy & Corrosion by Sharan – Narayan.
2. Corrosion Engineering 1st Edition Principles and Solved Problems by Branko Popov.
3. Handbook of Corrosion Engineering, Second Edition by: Pierre R. Roberge, Ph.D.

Course Outcomes:

1. Outline the electrochemistry of the corrosion process.
2. Identify and analyze the "Eight Forms of Corrosion".
3. Describe the effects of specific corrosion environments prevailing in the oil and gas industry.
4. Select appropriate corrosion monitoring and control techniques.
5. To design for corrosion protection, minimization.
6. Review and select appropriate materials for corrosion resistant applications.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

ALTERNATE ROUTES OF IRON AND STEEL MAKING
(Professional Elective - II)

Pre-Requisites: Iron making and steel making technologies and Thermodynamics and kinetics.

Course Objectives:

1. Introduce the various alternative routes of iron production and steel making and explain their need.
2. Familiarize the student about the application of thermodynamics and kinetics to extraction of iron.
3. The student will learn about continuous steel making process and secondary steel making processes.

UNIT-I

Introduction: Need for the development of alternative routes, approaches towards new techniques. Classification of processes. Principles: Thermodynamic and kinetic aspects of iron ore reduction in solid and liquid state using solid/gaseous reductants.

UNIT-II

Sponge iron production using rotary kiln, Fast met process, ITmk 3 process. Sponge iron production in HYL process, Finmet and HIB process.

UNIT-III

Smelting-Reduction Processes: Introduction need and significance of smelting reduction. Classification of SR processes. Raw materials, advantages and limitations, fundamentals of SR process, Details about COREX, fast melt processes.

UNIT-IV

Continuous steel making processes: Classification, advantages and limitation. IRSID, BISRA and WORCRA processes. Secondary steel making process: Classify objectives, advantages and limitations. Stirring technology, Injection metallurgy, Ladle furnace process.

UNIT-V

Vacuum treatment of steel: RH and DH processes, continuous casting of steel.
Post solidification process: Electro slag remelting and vacuum arc remelting process.

Text Books:

1. Steel making by A.K. Chakravarthy PHI. Publications.
2. Iron making and steelmaking: Theory and Practice, Ghosh Ahindra, Chatterjee Amit, PHI Learning Private Limited, (2001).

Reference Books:

1. Modern Steelmaking – Dr. R. H. Thupkary and V. H. Thupkary.
2. Steel making – Kudrin.
3. Fundamentals of steel making metallurgy – Brahma Deo and Rod Boom P and H publ 1993.

Course Outcomes:

Upon successful completion of this course the student will be:

1. Explain the principles of thermodynamics and kinetics for production of direct reduction of iron and pig iron.
2. Describe direct reduction of iron production by coal and gaseous based process.
3. Describe pig iron production by SR process.
4. Evaluate the operations in continuous steel making and secondary steel making units.
5. Analyze the various factors and methods to improve the quality of steel.
6. Identify the extraction processes suitable to the local available raw materials.
7. Interested to do research in iron and steel industries.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

COMPOSITE MATERIALS
(Professional Elective - II)

Pre-Requisites: Nil

Course Objectives:

1. Describe the importance of composite materials and its constituents.
2. Familiarize the students with various types of fibers, their properties and processing techniques.
3. Introduce the various process techniques for composite materials.
4. To demonstrate the relationship among synthesis, processing and properties in composite materials.

UNIT-I

Introduction, Classification of Composite materials based on structure and matrix and reniforcements, Advantages and applications of composites, Functional requirements of reinforcement and matrix materials.

UNIT-II

Types of reinforcements and their properties: Carbon, Boron, Glass, Aramid, Al_2O_3 and SiC fibers. Nature and manufacture of glass, carbon and aramid fibres, Comparison of fibres. Role of interfaces: Wettability and Bonding, The interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial strength.

UNIT-III

Fabrication of Polymeric Matrix Composites, Structure and properties of Polymeric Matrix Composites, Interface in Polymeric Matrix Composites, Applications. Fabrication of Ceramic Matrix Composites, Properties of Ceramic Matrix Composites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites, Applications of Ceramic Matrix Composites.

UNIT-IV

Fabrication of Metal Matrix Composites: Solid state fabrication, Liquid state fabrication and In-situ fabrication techniques. Interface in Metal Matrix Composites. Mechanical bonding, Chemical bonding and Interfaces in In-situ Composites. Discontinuously reinforced Metal Matrix Composites: Properties and Applications. Fabrication of Carbon fiber composites, properties, interface and applications.

UNIT -V

Micromechanics of Composites: Density, Mechanical Properties: Prediction of Elastic constants, Micro mechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties: Hydrothermal stresses and Mechanics of Load transfer from matrix to fiber.

Text Books:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.
2. An Introduction to Composite Materials, Hull, Cambridge, 2nd Edt. 1997.

Reference Books:

1. Composites, Engineered Materials Handbook, Vol.1, ASM International, Ohio, 1988.
2. Structure and Properties of Composites, Materials Science and Technology, Vol. 13, VCH, Weinheim, Germany, 1993
3. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman & Hall, London, 1994.

Course Outcomes:

1. Can classify the composites, know the required properties, reinforcements and matrix materials and uses of composites.
2. Able to explain how common fibers are produced and how the properties of the fibers are related to the internal structure and the interfaces obtained.
3. Knowledge of processing techniques for polymer matrix and ceramic matrix composites and their properties and uses.
4. Knowledge of processing techniques for metal matrix composite and their properties and uses.
5. Ability to arrive at different deformation and failure mechanisms of composite materials under different loading conditions in engineering applications.
6. Able to explain the microscopy elastic properties and strengths of the composite.

w.e.f. 2018-2019 academic year

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

ELECTRONIC MATERIALS
(Professional Elective - II)

Pre- Requisites: Nil

Course Objectives:

1. To learn the operating principle of several environmentally friendly energy technologies.
2. To identify the material issues relevant to these technologies and to evaluate various operational aspects associated with these technologies.
3. To provide students with broad knowledge of synthetic methodologies along with an understanding of the critical needs.

UNIT- I

Energy requirements in a global scale and in the Indian context. Global context in terms of reducing greenhouse-gas emissions that contributes to climate change. Develop the infrastructure to meet the needs other energy- consuming sectors, the scale of India's energy resources and its energy production. Examples of coal-based DRI, pulp and paper making and small-scale cement kilns.

UNIT-II

Evaluation of energy sources from the perspective of clean energy. Carbon equivalent The carbon footprint of various forms of energy. Renewable energy and carbon Credits.

UNIT- III

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

UNIT- IV

Technologies and function of Energy Storage devices, Batteries & Super Capacitors.

UNIT -V

Solar energy conversion devices, Wind and Mechanical Energy storages.

Text Books:

1. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, 2004.
2. Semiconductor Materials, Devices and Fabrication, Parasuraman Swaminathan, Wiley 2017

Reference Books:

1. Principles of Electronic Materials and Devices, S. O. Kasap, McGraw Hill Education, 2017.
2. Electronic Materials by Chelikowsky, James R., Franciosi, Alfonso (Eds.).
3. Electronic Materials and Processes Handbook by Charles Harper.

Course Outcomes:

After completing this course the student should be able to:

1. Indicate and explain important scientific parameters associated with electronic materials.
2. Describe different semiconductors and their properties with examples.
3. Explain the features and functioning of several electronic devices.
4. Describe the manufacturing processes associated with electronic materials and devices.
5. Use simple band diagrams understand optical activity of a semiconductor.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
0	0	3	1.5

MATERIALS PROCESSING LAB – II

Pre Requisites: Nil

Course Objectives:

This lab course is designed to know

1. To know the behaviour of the materials under various types of loading.
2. Provide knowledge and experience in the measurement of various material properties.
3. To operate the various equipment like Erichson cupping, Rolling mill etc.., and analyze the process in them.

List of Experiments:

1. Determination of forming limit diagram.
2. To study the kinetics of static re-crystallization in a cold worked metal.
3. To verify hall-Petch relation in mild steel specimens.
4. Determination of the work hardening and strain rate sensitivity of a metal.
5. Determination of the effect of plastic anisotropy on the deformation behaviour.
6. Determine the effect of rolling variables on the mechanical properties of metals.
7. To study the forging operations in the production of a hook.
8. To conduct the ring compression test to determine the friction coefficient.
9. Determination of the flow pattern in plasticine clay when extruded through a die.
10. To study the defects produced in rolled products.
11. Determine the effect of cold work on hardness of the given material.
12. Determine the Modulus of Rupture or flexural modulus by bend test.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Determine strain hardening exponent, effect of grain size and plastic anisotropy under various types of experiments/ practical conditions.
2. Determine the effect of process variables affecting various forming methods.
3. Work on forging, extrusion and rolling mills and analyze and interpret the outcome of the processes.
4. Prepare formal laboratory reports.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
0	0	2	1

ADVANCED COMMUNICATION LAB

Pre Requisites: Nil

Course Objectives:

Course Outcomes:

To be obtained from HSMC Department.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
0	0	3	1.5

ENVIRONMENTAL DEGRADATION OF MATERIALS LAB

Pre-Requisites: Nil

Course Objectives:

1. This lab course is designed to conduct the experiments on electro deposition, verification of Faraday's laws and evaluation of factors affecting on corrosion.
2. To provide understanding of basic electro kinetics.
3. To provide basic knowledge on current efficiency for various electrolytes and electro metallurgy processes.

List of Experiments:

1. Electroplating of copper on brass and to study the influence of current density on current efficiency.
2. Electroplating of Nickel using watt's bath and to study the influence of current density on current efficiency.
3. To anodise the given aluminium sample and to colour with a dye and to measure the thickness of the oxide film.
4. To determine the throwing power of electroplating bath.
5. Electroplating of chromium on mild steel and to study the influence of current density on current efficiency.
6. To understand the principles in galvanic cell corrosion.
7. To study the pitting corrosion of aluminium, stainless steel in suitable environments.
8. To conduct uniform corrosion.
9. Electro winning of copper by using aqueous electrolyte.
10. Electro winning of copper from ores.

Course Outcomes:

Through this laboratory practice, the student will be able:

1. To judge the process variables like current efficiency, current density.
2. To obtain desired electro deposition.
3. Hands on experience on equipment designed for evaluation of corrosion studies.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Met. Engg. II-Semester

L	T	P	C
2	0	0	0

INDIAN CONSTITUTION/ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Pre-Requisites: Nil

Course Objectives:

Course Outcomes:

To be obtained from HSMC department

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

INTRODUCTION TO INSTRUMENTATION

Pre- Requisites: Nil

Course Objectives:

To have a knowledge of:

1. Electronic Instruments.
2. Pressure measurements.
3. Flow measurements.
4. Vibration, Viscosity and Humidity Level measurement.
5. Various analyzers.

UNIT-I

Electronic Instruments: CRO- Storage oscilloscope – Digital voltage meter (DVM) –Digital multi meter – XY Recorder, Strip chart recorder – Digital recording- Data logger – Introduction to virtual instrumentation.

UNIT-II

Pressure Measurements: Unit of Pressure – Manometers- Different types, - Elastic type pressure gauges – Bourdon tube – Bellows – Diaphragm – Elastic elements with LVDT and strain gauge – Capacitive type pressure gauge – Measurement of vacuum – McLeod gauge – Thermal conductivity gauge – Ionisation gauge.

UNIT-III

Flow Measurements: Flow meters – Variable head type flow meter – Orifice plate – Venture tube – Positive displacement flow meter: Nutating disc, Reciprocating piston, oval gear and helix type flow meter – Rota meter – Mass flow meters.

UNIT-IV

Vibration, Viscosity, Humidity, Level Measurement: Mechanical type vibration measuring instruments – Seismic instruments as an accelerometer- Vibrometers – Viscosity – Saybolt viscometer. Humidity – Hot wire electro type hygro meter - Dew cell – Electrolysis type hygrometer.

UNIT- V

Analyzers: Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyzer – Sodium analyzer – Silica analyzer – Turbidity meter – Gas analyzer – NOx analyzer – H_2S analyzer – CO and CO_2 monitor, Dust & Smoke measurement.

Text Books:

1. Alan S. Morrris. Principles of Measurement and Instrumentation, Prentice-Hall of India Pvt., Ltd. New Delhi, 1999.
2. Ernest O Doeblin. Measurement Systems Application & Design, Tata McGraw Hill Publishing Co., New. Delhi, 1999.

Reference Books:

1. Murthy, D.V.S. Transducers and Instrument and Instrumentation, Prentice Hall of India Pvt. Ltd. New Delhi.
2. Patranabir, D. Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co., New Delhi 1999.
3. Jain, R.K. Mechanical and Industrial Measurements, Khanna Publishing, New Delhi, 1999.
   Liptak B.G. Instrumentation Engineers Hand Book (Measurement), Chilton Book Co., 1994 .

Course Outcomes:

1. The knowledge gained on electronic, pressure, flow and vibration measurement will provide a strong platform to understand the concepts on these subjects for further learning**.**
2. Comprehend various pressure measurements.
3. Make accuracy statements for various types of measurements.
4. Differentiate between digital and analogue measurements and demonstrate advantages/disadvantages of each.
5. To be able to describe the operation of instruments used for various gas, liquid and solid materials.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

MATERIAL CHARACTERIZATION TECHNIQUES

Pre-Requisites: Nil

Course Objectives:

1. To explain and describe the various working techniques of optical microscope, Scanning and Transmission Microscopes used for evaluating material properties.
2. To explain and describe the various working techniques of XRD, SPM, AFM for evaluating material properties.
3. To differentiate and compare between various characterization techniques.
4. Obtain knowledge on the various thermal analyses techniques.

UNIT – I

Optical Microscopy–Introduction, optical principles, Instrumentation, specimen preparation-metallographic principles, Imaging Modes, Applications, Limitations.

UNIT – II

(a) Scanning Electron Microscopy (SEM)-Introduction, instrumentation, Contrast formation, Operational variables, Specimen Preparation, Imaging Modes, Applications, and Limitations.

(b) Transmission Electron Microscopy(TEM)-Introduction, instrumentation, Specimen preparation –pre thinning, final thinning, Image modes-mass density contrast, diffraction contrast, Phase contrast, Applications, Limitations.

UNIT – III

X-Ray Diffraction (XRD) - Introduction, Basic principles of diffraction, X-ray generation, Instrumentation, Types of analysis, Data collection for analysis, Applications, Limitations.

UNIT – IV

Thermal Analysis: Introduction , Basic thermodynamics and heat transfer, common characteristics-Instrumentation, experimental parameters, Different types used for analysis ,Differential thermal analysis, Differential Scanning Calorimetry, Thermogravimetry, Dilatometry, Dynamic Mechanical analysis- Basic Principles, Instrumentation, working principles, Applications ,Limitations.

UNIT – V

Scanning Probe Microscopy (SPM) Introduction, Instrumentation, Scanning Tunneling Microscopy-Basics, Probe Tips Working environment, operational modes, Applications, Limitations.

Atomic Force Microscopy (AFM) –Basic Principles, instrumentation, operational modes, Applications, Limitations.

Text Books:

1. V.T. Cherapin and A.K. Mallik: Experimental Techniques in Physical Metallurgy, Asia Publishing House, 1967.
2. Robert F. Speyer: Thermal Analysis of Materials, Marcel Dekker Inc., New York, 1994.

Reference Books:

1. S.J.B. Reed: Electron Microprobe analysis, Cambridge University Press, London, 1975.
2. ASM Hand book: Materials Characterization, ASM International, 2008.

Course Outcomes:

At the end of the course, student will gain hands on experience on utilization of:

1. Will be able to use metallurgical microscopes to analyze the experimental results.
2. Understand the various specimen preparation techniques for SEM, TEM and analyze the experimental results.
3. Describe the construction of XRD machine and understand its principle and analyze / interpret the experimental results.
4. Conduct characterization measurement by thermal analysis and solve problem using the thermo dynamic principles.
5. Analyze, evaluate and interpret data and solve practical characterization problems using modern tools like SPM, AFM etc.
6. Knowledge on thermal analyses methods such as DSC, calorimetry, dilatometry and etc.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

CORROSION PROCESS AND CONTROL
(Open Elective – II)

Pre-Requisites: Nil

Course Objectives:

1. To list out various atmospheres responsible for corrosion and understand the various corrosion combating techniques.
2. To determine corrosion rate/ resistance of metals and alloys.
3. To demonstrate electrometallurgy principles in deposition winning and the efficiency of the bath.
4. To explain corrosion protection methods and tests.

UNIT-I

Introduction, Electro Chemistry principles, Corrosion, Introduction and Definition, electrochemical reactions, Polarization, passivity, environmental effects (oxygen, oxidizers, velocity, temperature, corrosive concentration, Galvanic coupling).

UNIT-II

Forms of corrosion, uniform corrosion, Two metal corrosion: Sacrificial anode, EMF and Galvanic Series, Environmental effects, Pitting corrosion: Pit shape and growth, Autocatalytic Nature of pitting, Crevice corrosion.

UNIT-III

Intergranular corrosion: Sensitization, weld decay, Knife-Line attack, Stress corrosion cracking: crack morphology, stress effects, environmental factors, metallurgical factors, Erosion corrosion: cavitation damage, fretting corrosion, Corrosion fatigue.

UNIT-IV

Corrosion prevention methods: Alteration of Environment (Inhibitors), Design, Coatings, cathodic and anodic protection. Material selection, Metallurgical aspects, Hydrogen damage (hydrogen blistering, Hydrogen embrittlement, Prevention).

UNIT-V

Modern theory and applications of corrosion: Introduction, free energy, cell potentials, emf series, applications of thermodynamics to corrosion, Corrosion rate expressions and measurements, corrosion testing.

Text Books:

1. Corrosion Engineering, M. G. Fontana, 3rd edition, McGraw-Hill, 1985.
2. Corrosion and Corrosion Control, H. H. Uhlig, Wiley, 1985.

Reference Books:

1. Theory of Corrosion and Protection of Metals, N. D. Tomashov, Macmillan, 1967.
2. Introduction to Electrometallurgy & Corrosion by Sharan – Narayan.
3. Corrosion Engineering 1st Edition Principles and Solved Problems by Branko Popov.
4. Handbook of Corrosion Engineering, Second Edition by: Pierre R. Roberge, Ph.D.

Course Outcomes:

At the end of the course the student will be able:

1. Able to interpret electro chemical phenomenon.
2. Can explain different types of corrosion and their causes and effect.
3. Able to identify the different remedial measures to be taken.
4. Able to design corrosion resistant structures and materials.
5. Determine the thermodynamic causes of corrosion.
6. Conduct corrosion tests and able to quantify the corrosion processes.
7. Able to graphically represent and interpret Eh-pH, pourbiax extrapolation techniques.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

TESTING OF MATERIALS
(Open Elective- II)

Pre-requisites: Nil

Course Objectives:

1. To gain and understanding of the response of various metals under the application of stress and/or temperature.
2. Obtain a working knowledge of various hardness testing machines BHN, VHN, RHN.
3. Obtain a working knowledge of creep and fatigue and analysis of data.

UNIT–I

Introduction, Importance of testing.

Hardness Test: Methods of hardness testing – Brinell, Vickers, Rockwell hardness tests.

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

UNIT-II

The Tension Test: Engineering stress-strain and True stress-strain curves. Tensile properties, conditions for necking. Stress-Strain diagrams for steel, Aluminum and cast iron.

UNIT-III

Fatigue Test: Introduction, Stress cycles, S-N Curve, Effect of mean stress, Mechanism of fatigue failure, Effect of stress concentration, size, surface condition and environments on fatigue.

UNIT–IV

Creep and Stress Rupture: Introduction, The creep curve, Stress-rupture test, Structural changes during creep, Mechanism of creep deformation, theories of creep. Fracture at elevated temperature.

UNIT–V

NDT: Principle, Operation, Advantages and Limitations of Liquid Penetrant, Magnetic Particle, Radiography and Ultrasonic tests.

Text Books:

1. Mechanical Metallurgy – G. E. Dieter, Third edition, published by Newyork Mc Graw Hill,1986.
2. Mechanical behavior - Ed. Wulf.

Reference Books:

1. Mechanical Metallurgy – White & Lemay.
2. Testing of Metallic Materials - A.V.K. Suryanarayana.

Course Outcomes:

At the end of the course the student will be able to:

1. Understand and interpret the results of various hardness tests and impact tests.
2. Evaluate various tensile properties of ferrous and Non Ferrous Metals and solve problems related to the tensile tests.
3. Analyze the modes of failure occurring due to fatigue and suggest remedial measures.
4. Analyze the methods of failure of materials at high temperature by creep and strength rupture and the mechanisms responsible for fracture.
5. Determine appropriate tests to be employed to determine the given mechanical properties using both destructive and non-destructive techniques.
6. Knowledge of various testing methods based on destructive & Non destructive techniques and their importance in enhancing service life of the component.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

LIGHT METALS & ALLOYS
(Professional Elective – III)

Pre-Requisites: Nil

Course Objectives:

This course is mainly intended to deal with:

1. To demonstrate various alloy systems and their phase diagrams.
2. To highlight the importance of alloy selection.
3. To demonstrate the influence of composition, processing and microstructural effect on properties of the non ferrous alloys.

UNIT-I

Aluminium alloys: Classification, Properties and applications, Physical metallurgy of Al-Cu alloys, Al-Mg alloys, Al-Zn alloys, Al-Mn alloys, Al-Si alloys, and Al-Li alloys, Ternary phase diagrams: Al-Cu-Mg alloys, Al-Si-Mg alloys and Al-Zn-Mg alloys.

UNIT-II

Magnesium Alloys: Classification, properties and applications, Alloying elements to magnesium and their purpose, Designation of magnesium alloys, Temper designation of magnesium alloys, Precipitation hardening in Magnesium alloys, Mg-Al-Zn alloys, Corrosion resistance of Mg-alloys.

UNIT-III

Titanium alloys: Classification, properties and applications, Interstitial solid solutions of titanium, Strengthening mechanisms of Titanium alloys. Titanium alloys for aerospace and aero engine applications.

UNIT-IV

Alpha Ti alloys, Beta Ti-alloys, Alpha plus Beta Ti alloys, Ti-6Al-4V, Ti-8Al-1Mo-1V, Ti-13V-11Cr-3Al alloys. Heat treatment and thermomechanical processing of alpha, alpha-beta and beta titanium alloys.

UNIT-V

Beryllium alloys: Classification properties and applications, Processing of Beryllium alloys, Al-Be alloys, Corrosion resistance of Beryllium alloys.

Text Books:

1. Light alloys: Metallurgy of the light metals by I. J. Polmear.
2. Introduction to Physical Metallurgy – S.H. Avner.

Reference Books:

1. Heat treatment, structure and properties of Nonferrous alloys- Charlie Brooks, ASM Metals Park, Ohio, USA.
2. Engineering Physical Metallurgy – Lakhtin.
3. ASM Metals Handbook Vol-1 & 2.
4. Metallurgical abstracts on light metals and alloys Keikinzoku Shōgakukai, Light Metal Educational Foundation., 1999.

Course Outcomes:

At the end of the course, the student will be able:

1. Able to classify Aluminum alloys and understand the importance of structure - property correlation in binary and ternary alloys.
2. Knowledge of Magnesium and Zinc alloys and their applications.
3. List out the properties of Titanium and its alloys and comprehend their usage.
4. Analyze the importance of properties and applications of Beryllium alloys.
5. Can develop and design stronger and safer new light weight alloys with the knowledge of metal properties for specialized applications with minimum consumption of materials.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

FATIGUE AND FRACTURE MECHANICS
(Professional Elective – III)

Pre-Requisites: Nil

Course Objectives:

1. To study the different types of fatigue failures and their mechanisms in the engineering applications.
2. To study the basic theory of fracture mechanics and its relationship with fatigue and creep failure mechanisms.
3. To understand the damage tolerance approach in the life estimation of structures.

UNIT-I

Introduction and historical overview, Types of fatigue – low cycle fatigue, high cycle fatigue, very high cycle (giga cycle) fatigue, Fatigue test methods and equipment, Total life approaches based on cyclic stress and cyclic strain, Cyclic hardening and softening in single crystals and polycrystals.

UNIT-II

Crack initiation and propagation, Mechanisms, Macrostructural and microstructural aspects, Use of fracture mechanics in fatigue.

UNIT-III

Local strain approach, effect of different factors on fatigue – Stress concentration, Size, Surface, Temperature, Frequency, Environment, Microstructure, Residual stresses, Fretting, Creep-fatigue interaction, Multiaxial stresses, Thermomechanical loading, Variable amplitude loading, Load sequence, Crack closure.

UNIT-IV

Fatigue behaviour of different materials – Metallic materials and weldments, Ceramics, Polymers, Composites, Metallic glasses, Shape memory alloys, Ultrafine grained materials, Nanocrystalline materials, Biomaterials, Metallic foams.

UNIT-V

Elementary theories of fracture, Griffith's theory of brittle fracture, Strain-Energy Release Rate , Stress Intensity Factor, Fracture Toughness and Design, K_{IC} Plane-Strain Toughness Testing, Plasticity Corrections, Crack Opening Displacement, J-Integral, R Curve, Probabilistic Aspects of Fracture Mechanics, Toughness of Materials.

Case studies on fatigue failures, Design considerations, Methods for fatigue life improvement.

Text Books:

1. Fatigue of Materials, Suresh, Cambridge India, 2015.
2. Fracture Mechanics, Fundamentals and Applications, T.L. Anderson, CRC Press 2017.

Reference Books:

1. Ewalds,H.L., R.J.H. Wanhill(1986). Fracture Mechanics, Edward Arnolds; USA.
2. R.W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley & Sons, 1976, p 229–230.

Course Outcomes:

After completing this course, the student will have:

1. The ability to identify the characteristic fatigue failures in the engineering structures.
2. Knowledge of connecting fracture mechanics concepts to fatigue failure.
3. Knowledge of fatigue failure mechanisms in non-metallic materials.
4. Complete understanding of flow stress and S-N curve.
5. Knowledge on the methods of combating, preventing further failure.
6. Able to comprehend the failure theories using case studies.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

FAILURE ANALYSIS
(Professional Elective– III)

Pre-Requisites: Nil

Course Objectives:

1. To highlight factors governing the failure of materials and types of failures.
2. To evaluate the mechanisms and environmental effects associated with failure.
3. To identify various failures in heat treatment and deformation processing, and methods to prevent them.

UNIT-I

Aims of failure analysis, general procedures of failure analysis. Important factors causing the premature failure of metallic components and structures., classification of failure sources: Design deficiencies, material deficiencies, processing deficiencies, assembly errors, service conditions, neglect and improper operation. Methods and equipment for failure analysis, Sample selection and treatment, equipment for materials examination, materials analysis equipment for failure analysis, commonly used NDT methods.

UNIT-II

Fractography. Types of failures: ductile, brittle, fatigue, creep, corrosion, wear.

UNIT-III

Failure mechanisms. Embrittlement phenomena. Environmental effects. Fatigue failures, fractography, effect of variables: part shape, type of loading, stress concentration, metallurgical factors, etc. Wear failures, adhesive, abrasive, erosive, corrosive wear.

Corrosion failures, types of corrosion: uniform, pitting, selective leaching, intergranular, crevice, etc. Elevated temperature failures, creep, thermal fatigue, microstructural instability, oxidation.

UNIT-IV

Failures due to faulty heat treatments. Failures in metal forming and welding.

UNIT-V

Case studies in failure analysis and prevention of failures.

Test Books:

1. Failure Analysis of Engineering Materials, Charles Brooks, Ashok Choudhury, Charlie R.Brooks, McGraw-Hill Education; 2001.
2. Metallurgical Failure Analysis: Techniques and Case Studies Author(s): KannadiPalankeezhe Balan, ISBN: 978-0-12-814336-0.

Reference Books:

1. Failure Analysis: Fundamentals and Applications in Mechanical Components, Jose Luis Otegui, Springer, 2016.
2. Failure Analysis of Engineering Materials (Mcgraw-Hill Professional Engineering) by Charles R Brooks and Ashok Choudhury.
3. Failure Analysis Case Studies: A Source Book of Case Studies Selected from the Pages of Engineering Failure Analysis 1994-1996 by D R H Jones.

Course Outcomes:

After completing this course the student will have:

1. The ability to identify the types of failures in engineering components under service.
2. Able to determine fracture toughness of ductile and brittle materials.
3. Knowledge of the tools and techniques to perform failure analysis.
4. Ability to perform fractographic analysis after various failures.
5. The ability to identify different failure mechanisms resulting from manufacturing processes.
6. Able to analyze the failures using case studies and select tools for failure analysis.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

SURFACE ENGINEERING

(Professional Elective -IV)

Pre-Requisites: Thermodynamics, Physical Metallurgy.

Course Objectives:

1. To provide a state- of- the art knowledge to the students and various surface engineering techniques.
2. To explain the importance, need of surface engineering and past, present and future status of surface engineering.
3. To comprehend the laser processing, electrons and ion beam processing of surfaces, to characterize and evaluate coatings.
4. To understand the combat techniques to protect surfaces from wear, corrosion and other failure causing environments.

UNIT-I

Introduction to surface modification, need for surface modification, surface properties, surface property modification, history of surface modification techniques.

UNIT-II

Plating and coating process: concept of coating, types of coatings, properties of coatings, hard facing, anodizing, PVD, CVD, Electro deposition, Electro less deposition, hot deposition, hot dipping.

UNIT-III

Thermo-chemical Processes: carburizing, nitriding, carbo-nitriding, nitro carburizing, Boronising, Plasma nitriding, thermal spraying, Plasma spraying, Alumnizing.

UNIT-IV

Thermal Processes: Flame hardening, induction hardening, laser hardening, laser surface alloying, laser cladding, electro-beam hardening.

UNIT-V

General design principles related to surface engineering, design guidelines for surface preparation, surface engineering solution to specific problems. Case studies related to Engineering Components, Shafts, Bearings, Turbine blades.

Text Books:

1. Advanced thermal assisted surface engineering processes, Ramnarayan Chattopadhyay, published by Kluwer Academy Publishers 2004.
2. Surface engineering of metals: principles, Equipment and techniques, Tadeusz Burokowski, Tadeusz Wierzchon, CRC Press 1998.

Reference Books:

1. Advanced techniques for surface engineering, W.Gissler, Herman A.Jehn, published by Kluwe Academy Publishers in 1992.
2. Laser material processing, William M.Steen, fourth edition, Springer.

Course Outcomes:

1. Gain knowledge of different surface properties, appreciate the need for surface modification and past practices.
2. Knowledge of plating and coatings techniques.
3. Knowledge of modification by chemical process.
4. Knowledge of modification by thermal process.
5. Design various surface modifications according to the needs, compatibility and efficiency of the processes.
6. This course provides an opportunity to the students to engineer the microstructure for an enhanced performance based on the need in actual practice.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

ENERGY MATERIALS
(Professional Elective – IV)

Pre-Requisites: Nil

Course Objectives:

1. To understand energy requirements on domestic and international scale.
2. To learn the operating principle of several environmentally friendly energy technologies.
3. To identify the material issues relevant to these technologies and to evaluate various operational aspects associated with these technologies.

UNIT-I

Energy requirements in a global scale and in the Indian context. Global context in terms of reducing greenhouse-gas emissions that contribute to climate change. Develop the infrastructure to meet the needs other energy- consuming sectors, the scale of India's energy resources and its energy production .Examples of coal-based DRI, pulp and paper making and small-scale cement kilns.

UNIT-II

Evaluation of energy sources from the perspective of clean energy. Carbon equivalent The carbon footprint of various forms of energy. Renewable energy and carbon Credits.

UNIT-III

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

UNIT-IV

Technologies and function of Energy Storage devices, Batteries & Super Capacitors.

UNIT-V

Solar energy conversion devices, Wind & Mechanical Energy storages.

Text Books :

1. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, 2004.
2. Energy Materials by Duncan W. Bruce, Dermot O'Hare, Richard I. Walton.

Reference Books:

1. Materials Science in Energy Technology 1st Edition by G Libowitz.
2. Advanced Energy materials 1st Edition by Ashutosh Tiwari, Sergiy Valyukh.
3. Energy Storage & Conversion: Materials & Devices by A. Kumar, S. K. Das.

Course Outcomes:

After completing this course the student should be able to:

1. Evaluate an energy technology for environmental friendliness.
2. Explain the operating principle of several energy technologies.
3. Indicate the material requirements for these energy technologies.
4. Demonstrate the ability to understand the characterization, performance, and failure data related to these technologies.
5. Comprehend various energy storage, conversation devices and technologies.
6. Demonstrate the various renewable energy sources and characterize the materials which can be used.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester

L	T	P	C
3	0	0	3

NON DESTRUCTIVE TESTING
(Professional Elective – IV)

Pre-Requisites: Nil

Course Objectives:

1. Provide an opportunity to learn visual methods, electrical methods and magnetic methods.
2. To develop a fundamental understanding of ultrasonic testing of material and radiographic methods.
3. To be able to select the suitable NDT methods for particular environments.

UNIT-I

Introduction; Visual Methods**:** Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection.

UNIT-II

Penetrant Flaw Detection**:** Principles, Process, and Penetrant systems; Liquid penetrant materials; Emulsifiers; cleaners developers, sensitivity; Advantages, Limitations, applications.

MAGNETIC METHODS**:** Advantages, Limitations, Methods of generating fields; magnetic particles and suspending liquids Magnetography, field sensitive probes; applications. Measurement of metal properties.

UNIT-III

Electrical Methods: Eddy current methods; potential-drop methods, applications.

Electromagnetic Testing: Magnetism; Magnetic domains; Magnetization curves; Magnetic Hysteresis; Hysteresis-loop tests; comparator - bridge tests Absolute single-coil system; applications.

UNIT-IV

Ultrasonic Testing Of Materials: Advantages, disadvantages, Applications, Generation of Ultrasonic waves, general characteristics of ultrasonic waves; methods and instruments for ultrasonic materials testing; special techniques. Acoustic emission methods: Basic Principles, methods and applications.

UNIT-V

Radiographic Methods: Limitations; Principles of radiography; sources of radiation, Ionizing radiation - X-rays sources, gamma-rays sources Recording of radiation; Radiographic sensitivity; Fluoroscopic methods; special techniques; Radiation safety.

Text Books:

1. Non-Destructive Testing by P. Halmshaw.
2. Ultrasonic Testing of Metals; J Krantkramer and H. Krantkramer, Spinger Vekg, 1987.

Reference Books:

1. Testing of Materials by A. V. K. Suryanarayana.
2. Metals Handbook Vol. II, Nondestructive inspection and quality control.
3. R. C. McMaster, Ed., Nondestructive Testing Handbook (American Society for Nondestructive Testing, The Ronald Press Co., New York, 1959), vol I & II.
4. J. F. Himsley, Non-destructive Testing, Macdonald and Evans, London, 1959.

Course Outcomes:

The end of the student gain will be:

1. Complete knowledge on microscopic evaluation and dynamic inspection.
2. Knowledge about application of NDT methods like visual observation, penetrant detection, electrical methods etc.
3. Ability to use ultrasonic testing and radiographic methods for checking various types of defects.
4. Selection of suitable NDT methods for various environments.
5. Documentation of testing and evaluation of results for further analysis.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

SEMINAR

Pre- Requisites: Nil

Course Objectives:

Course Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**4**	**2**

MINI PROJECT

Pre-Requisites: Nil

Course Objectives:

1. This course is mainly intended to make the students acquire real time practical experience on the industry oriented processes, technologies, and applications once again.
2. Students will be exposed to sophisticated equipments and modern technologies.

Course Outcomes:

At the end of the course the student will be able to:

1. Identify a research problem after thorough literature review in metallurgical engineering, plan and execute experimental work to obtain results.
2. Further analyze the results, prepare a technical report and make a presentation.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. I-Semester **L T P C**
3

MAJOR PROJECT (PHASE-I)

Pre-Requisites: Nil

Course Objectives:

1. This course is mainly intended to make the students acquire real time practical experience on the industry oriented processes, technologies, and applications once again.
2. Students will be exposed to sophisticated equipments and modern technologies.

Course Outcomes:

At the end of the course the student will be able to:

1. Identify a research problem after thorough literature review in metallurgical engineering, plan and execute experimental work to obtain results.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

ALLOY STEELS
(Open Elective - III)

Pre-Requisites: Nil

Course Objectives:

This course deals with:

1. Describe the physical metallurgy of steels and alloy steels.
2. Explain the microstructure and properties of steels and alloy steels.
3. Make judgments on microstructural evolution and properties developed in alloy steels.

UNIT – I

Low-carbon Mild steels: Introduction. Cold forming steels, High strength packing steels; HSLA steels; Low-carbon Ferrite pearlite steels, structure property relationships, strengthening mechanisms, Formability of HSLA steels.

UNIT – II

Medium- High carbon ferrite-pearlite steels – structure property relationships, Bainitic steels, Low-carbon bainitic steels requirements, development and choice of alloying elements, Mechanical properties, microstructure and impact properties, High-Carbon bainitic steels.

UNIT – III

Ultra-high strength steels: Classification and applications. Description steels tempered at low temperatures, secondary hardening, thermo-mechanical treatments, rapid austenitizing treatments, structure-property relationships in tempered martensite, cold-drawn pearlite steels, maraging steels.

UNIT – IV

Stainless steels: Classification, Composition, role of alloying elements, Heat treatment, microstructure and applications.

UNIT- V

Tool steels and Heat resistant steels: Classification, Composition, role of alloying elements, Heat treatment, microstructure and applications.

Text Books:

1. Physical Metallurgy and the Design of steels: F. B. Pickering, Applied Science publisher, London, 1978.
2. The physical Metallurgy of steels: W. C. Leslie by Hempisphere Publishers Corporation, 1981.

Reference Books:

1. Alloys Steels – Wilson.
2. Heat Treatment of steels – Rajan & Sharma.

Course Outcomes:

1. Develop an appreciation for the microstructural complexity in alloys and how simple analytical solutions are often adequate to cope with these problems and know their limitations.
2. Know the importance of structure - property correlation study in HSLA, Ultra high strength steels etc.., and their suitable applications.
3. Select suitable materials for corrosion resistance applications.
4. Analyze the importance of composition, heat treatment and microstructure effects on properties and uses of tool steels and heat resistant steels.
5. Able to apply the knowledge gained on microstructural evolution and its stability to optimize the processing routes for specific applications.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

HIGH TEMPERATURE MATERIALS
(Open Elective – III)

Pre-Requisites: Nil

Course objectives:

1. To learn and design material's microstructure for high temperature applications.
2. To learn scientific issues related to high temperature such as creep, oxidation and material degradation.
3. To study the properties which improve high temperature resistance.

UNIT-I

Creep, Types of Creep, Testing methods, Creep data presentation, Creep Curve and stages of creep, Mechanisms of Creep and creep resistant steels.

UNIT-II

Fatigue, thermal fatigue, ageing, structural changes, material damage, crack propagation, damage mechanics, life time analysis, Creep-Fatigue interaction.

UNIT-III

Oxidation, Kinetics of oxidation, Factors controlling oxidation, Hot Corrosion, Testing methods, Mechanisms of hot corrosion, erosion, Hot corrosion properties of carbon steels and stainless steels.

UNIT-IV

Super alloys: their processing, high temperature mechanical properties, Corrosion behaviour, Ceramics for applications in refractory technology, Properties and applications of high temperature polymers.

UNIT-V

Refractory metals and alloys, Intermetallics, Carbon-Carbon composites, Ceramic matrix composites for refractory applications, Industrial, defence and nuclear applications.

Text Books:

1. Evans, R.W and Wilshire, B. Creep of metals and alloys, Institute of metals, 1985, London.
2. J.R. Davis, ASM Specialty Handbook: Heat- resistant materials, ASM, 1997.

Reference Books:

1. Introduction to the High Temperature Oxidation of Metals by Neil Birks, Gerald H. Meier, and Frederick S. Pettit (Paperback - Jul 23, 2009)
2. The Super-alloys: Fundamentals and Applications, Roger C. Reed, Cambridge University Press; 1 edition (July 31, 2008)
3. High Temperature Coatings, Sudhansu Bose, Butterworth-Heinemann; 1 edition (February 6, 2007)
4. Polyimides and Other High Temperature Polymers: Synthesis, Characterization and Applications, K. L. Mittal, Brill Academic Publications, 2009.

Course Outcomes:

1. Outline the different processes responsible for failure of materials at high temperature.
2. Able to relate the causes for creep failure and choice of creep resistant materials.
3. Able to interpret the structural changes taking place during fatigue and aging and carry out analysis of data.
4. Able to interpret the chemical causes for failure at high temperature.
5. Distinguish the role of ceramics, polymers, super alloys etc., at high temperature.
6. Analysis of data available for design and improve the existing materials.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

SOLIDIFICATION PROCESSING
(Professional Elective - V)

Pre-Requisites: Material Processing-1, Physical Metallurgy

Course Objectives:

1. To inculcate the metallurgical aspects during solidification of metal and alloys.
2. To import knowledge about solidification of casting with detail emphasis on calculation of gating/riser system.
3. To import knowledge about solidification behaviour during welding and effect of microstructure in HAZ.

UNIT-I

Principles of solidification: Nucleation and growth of pure metals and alloys, Cooling curves, heat transfer associated in nucleation and growth eutectic solidification; Homogeneous and Heterogeneous nucleation.

UNIT-II

Solidification of ingots and castings: formation of plane front columnar, equiaxed and dendritic structures, Effect of composition, moulding materials and cooling rate on solidification pattern.

UNIT-III

Segregation and shrinkage phenomena in castings, calculation of solidification time for casting, heat transfer calculations in metal casting, principles of chill design.

UNIT-IV

Heat transfer in weldments, dissipation of welding heat, cooling rates, weld metal cooling curves, peak temperature, calculating width of heat affected zones, solidification rate and affects of heat input. .

UNIT-V

Heat conduction using without phase change and with phase change by finite element method, finite volume method and finite differences methods.

Text Books:

1. J F Lancaster, Physics of welding, Pargamon press, 1986.
2. R. W. Heine, C. R. Loper, P. C. Rosenthal: Principles of metal casting, Mc Graw Higher Ed 1976.

Reference Books:

1. W. Kurz and D.J. Fisher, Fundamentals of Solidification, CRC Press, 1998.
2. John Campbell, castings, Butterworth Heinemann, edition-1, 1998.
3. Doru Micheal stefanescu-Science and engineering of casting Solification, Second Edition (2008)
4. G.J.Davies – Solidification and casting, Applied science publishers, 1973
5. Solidification Processing; Fleming, M.C., McGraw-Hill, N.Y., 1974
6. Solidification of Casting; Ruddle, R.W., Institute of Metals, 1957

Course Outcomes:

The student will be able to:

1. Understand the principles and practice of directional solidification.
2. Understand the procedures used for controlling porosity and shrinkage during solidification processing.
3. Understand the microstructural differences between cast and wrought metallic alloy products.
4. Understanding the microstructural mechanisms associated with metals joining operations including heat affected zones.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

NON METALLIC MATERIALS
(Professional Elective - V)

Pre-Requisites: Nil

Course Objectives:

1. To introduce the student to the range of non-metallic materials available for engineering.
2. To understand the classification and significance of nonmetallic materials to apply them in Industries.
3. To get an exposure to the techniques associated with the synthesis, processing and characterization of these materials.
4. To become aware of the applications where these materials are preferred.

UNIT-I

Definition and classification of materials, comparison of properties of metals and nonmetallic materials. Nature of bonding.

UNIT-II

Ceramics: Structure, defects. Ionic and semiconducting behavior. Processing techniques. Glasses and glass-ceramics, glass fibres. Structural ceramics: fracture toughness, toughening mechanisms. Special ceramics: Electro-optic, dielectric, ferroelectric, piezoelectric, magnetic, superconducting, laser and dilute magnetic and bio-ceramics.

UNIT-III

Polymers: Structure, properties and applications of thermoplastics and thermosets. Conducting and biopolymers.

UNIT-IV

Composites: Introduction, classification, and applications of composite materials. Manufacturing of Polymer matrix, metal matrix, and ceramic matrix composites.

UNIT-V

Textiles. Adhesives, and Foams: Introduction, classification and applications of textile materials. Structure of Adhesives and their applications. Classification and applications of foam materials, Manufacturing methods of industrially important adhesives and foams.

Text Books:

1. Textbook of Polymer Science; Fred W. Billmeyer, Wiley 2007.
2. Introduction to Ceramics; Kingery, Bowen, Uhlman. Wiley India Pvt Limited, 2012.

Reference Books:

1. Science and Engineering; Krishan K. Chawla, Springer, 2012.
2. W.S. Smith: Principles of Materials Science and Engineering, McGraw-Hill.
3. V. Raghavan: Materials Science and Engineering, Prentice-Hall.

Course Outcomes:

After completing this course the student can:

1. List the prominent non-metallic materials available for engineering applications.
2. Indicate the synthesis and processing steps associated with these materials.
3. Indicate the structure property relations in these materials.
4. Understand the behavior of each material in detail.
5. Indicate the uses for which these materials are preferred.
6. Can use the materials in preferred applications.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

FUNCTIONAL MATERIALS
(Professional Elective – V)

Pre-Requisites: Nil

Course Objectives:

1. To introduce the student to functional materials and the science behind the performance of the functional materials.
2. To enable the student to understand the applications of functional materials.
3. To study about semi conductors, dielectrics, Peizo, Ferro electric and smart materials.

UNIT-I

Characteristics and types of functional materials. Crystal structure and Properties. Effect of size on properties, effect of interfaces on properties. Magnetic materials and storage applications.

UNIT-II

High Temperature Behaviour of Amorphous and Nanocrystalline Soft Magnetic Materials Magnetic storage devices store data using a combination of magnetic fields and binary data, Band structure, Semiconductor devices – Theory, examples and applications of Optically active materials.

UNIT-III

Basics of semiconductor electrical properties, operation of the semiconductor devices. Eg: Band structure, 2. Diode, 3. MOS device capacitor 4. MOS transistor structure and operation and 5. Transistor formation and 6. Transistor isolation.

UNIT-IV

Dielectrics, piezo and ferroelectric materials: Introduction, properties, applications. Recent developments in advanced dielectric, piezoelectric and ferroelectric materials. High strain high performance piezo- and ferroelectric single crystals; Electric field-induced effects and domain engineering; Morphotropic phase boundary related phenomena; High power piezoelectric and microwave dielectric materials; Nanoscale piezo- and ferroelectrics.

UNIT-V

Smart materials: Introduction, definition, applications, factors affecting properties of smart materials. Applications in electronic, communication, aerospace, automotive, energy industries.

Text Books:

1. Functional Materials: Electrical, Dielectric, Electromagnetic, Optical and Magnetic applications; Deborah D L Chung, World Scientific Publishing, 2010.
2. Advanced Functional Materials (Advanced Material Series) by Ashutosh Tiwari, Lokman Uzun.

Reference Books:

1. Functional Materials 1st Edition, Preparation, Processing and Applications by S.Banerjee, A.K.Tyagi.
2. Advanced Functional Materials by Woo, Hee-Gweon, Li, Hong.
3. Functional Materials: Properties, Performance and Evaluation by Ewa Klodzinska.

Course Outcomes:

After completing the course the student will be able to:

1. Indicate the various types of functional materials.
2. Explain the principle of operation of the functional materials.
3. Indicate the applications of the functional materials.
4. Will be able to understand factors that affect the properties.
5. Identify advanced functional materials.
6. Understand properties of different types of functional materials.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

POWDER METALLURGY
(Professional Elective - VI)

Pre-Requisites: Nil.

Course Objectives:

1. To build the necessary back ground of emergence and importance of powder metallurgy scope and limitations.
2. Obtain a necessary knowledge about various powder production techniques and characteristics.
3. Obtain a working knowledge of compaction and sintering techniques.
4. Gain an effective knowledge of applications of powder metallurgy products.

UNIT–I

Introduction: Emergence and importance of powder metallurgy**:** Comparison of powder metallurgy with other fabrication techniques, its scope and limitations.

UNIT–II

Characterization and production of powders**:** General characteristics of metal powders, particle shape, flow rate, apparent density, and specific surface area, particle size distribution. Different methods of production of metal powders: influence of manufacturing process on powder characteristics.

UNIT–III

Compaction**:** Theory of consolidation: Pressure transmission in powders. Compressibility and compactability of powders, Green strength, Hot isostatic pressing, Powder rolling.

Sintering: Mechanisms of Sintering, Factors affecting sintering, Activated sintering, Liquid phase sintering, Sintering atmospheres, Properties of sintered parts.

UNIT–IV

Applications: Porous parts: Self-lubricating bearings, filters: Dispersion strengthened alloys by powder metallurgy route: Cu / Al_2O_3, Sintered Aluminum Powder. Electrical materials: Tungsten lamp filaments, electrical contacts, welding electrodes.

UNIT –V

Magnetic materials: Soft magnetic materials (Fe, Fe-Ni); Permanent magnets (Alnico, $SmCo_5$), Cemented carbides; Cermets.

Text Books:

1. Powder Metallurgy – A.K. Sinha.
2. Powder Metallurgy Technology - G S Upadhyaya.

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Reference Books:

1. Introduction to Powder Metallurgy – J.S. Hirshhorn.
2. Powder Metallurgy Principles – F.V. Lenel.
3. Powder Metallurgy Practice and Applications – R.L. Sands & C.R. Shakespeare.
4. Powder Metallurgy by R.M German.
5. Powder Metallurgy by TC Angelo and R. Subramanyam.

Course Outcomes:

At the end of the course the student will be able to:

1. Explain basic conditions of successful applications of powder metallurgy technology for production of materials and components in comparison with other fabrication techniques.
2. Formulate advantages and disadvantages of powder metallurgy technique.
3. Evaluate and propose optimum technology for preparation of powder materials.
4. Evaluate and propose optimum compaction and sintering techniques.
5. Can optimize material and technological parameters for efficient production with minimum rejects.
6. Can develop and design powder metallurgical components for specific applications and needs of various industries.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

BIO MATERIALS
(Professional Elective - VI)

Pre- Requisites: Nil

Course Objectives:

1. To introduce the student to the range of biomaterials and the science and engineering of biomaterials.
2. To understand constraints associated with the use of biomaterials.
3. To study various real time applications of bio materials.

UNIT-I

Introduction to basic concepts of Materials Science, Salient properties of important material classes. Property requirement of biomaterials. Concept of biocompatibility. Structure and properties of biological cells & tissues. Cell-material interactions and foreign body response.

UNIT-II

Assessment of biocompatibility of biomaterials. In vitro biochemical assays (cellular adhesion, cellular viability using MTT, osteogenic differentiation using ALP assay; Biomnuneralisation using Osteocalcin assay). In vivo testing and histocompatibility assessment. Genotoxicity assessment (Physical damage to DNA by biomaterial eluates).

UNIT–III

Important bio-metallic alloys: Ti-based, stainless steels, Co-Cr-Mo alloys. Bio-inert, Bioactive and bioresorbable ceramics. Biocompatibility of Alumina & Carbon Nanotube Reinforced Hydroxyapatite. Glass -ceramics for dental restoration applications.

UNIT–IV

Processing and properties of different bio-ceramic materials with emphasize on hydroxyapatite. Synthesis of biocompatible coatings on structural implant materials. Plasma spraying of carbon nanotube reinforced hydroxyapatite on Ti-6Al-4V substrate, in-vitro cytocompatibility. Microstructure and properties of glass-ceramics. Biodegradable polymers.

UNIT-V

External field and cell – material interaction, Tissue Engineering and Wound healing. Design concept of developing new materials for bio-implant applications.

Text Books:

1. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.
2. Comprehensive structural interity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karihalo, Elsevier Academic Press, 2003.

Reference Books:

1. Biomaterials Science and Biocompatability, Fredrick H. Silver and David L. Christiansen, Piscataway, Springer, New Jersey.
2. Biological Performance of Materials: Fundamentals of Biocompatibility, Janathan Black, Marcel Dekker, Inc., New York and Basel, 1981.
3. Basic Cell Culture: A Practical Approach, Edited by J.M. Davis, IRL Press, Oxford University Press, New York, 1994.

Course Outcomes:

After completing the course, the student will be able to:

1. Explain the types of Biomaterials and their relative advantages and disadvantages.
2. Indicate the constraints placed on the use of materials in biological environments.
3. Explain the characterization of materials from the perspective of application as a biomaterial.
4. Understand the bio compatibility of materials
5. Develop and process new advanced materials
6. Develop coatings and implant materials.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. II-Semester

L	T	P	C
3	0	0	3

TRANSPORT PHENOMENA
(Professional Elective - VI)

Pre-Requisites: Nil

Course Objectives:

1. This course will introduce the concepts of fluid flow, heat transfer and mass transfer with behavior and processing of engineering materials as the focus.
2. To learn Newton's law of viscosity, Navier-strokes equation, Darcy's law.
3. To analyze the heat transfer methods and also study methods of diffusion.

UNIT-I

Balance of quantities using elemental volume approach, continuity equation Newton's law of viscosity.

UNIT-II

Navier-Stokes equation, laminar flow problems, exact solutions in rectangular, cylindrical and spherical coordinate systems.

UNIT-III

Friction factors, correlations for turbulent regime, Darcy's law, flow through porous media, Fundamentals of heat conduction, convection, radiation and their combined effect.

UNIT-IV

Steady and unsteady heat transfer, exact analytical solutions, correlations for conjugate heat transfer. Coupled phenomena in transport, Non-dimensional numbers and their correlations of different regimes and analogies.

UNIT-V

Diffusion and its application in solid state, convective mass transfer, unsteady diffusion in finite and infinite bodies, diffusion and chemical reactions.

Text Books:

1. Transport phenomena, 2nd Edition: R. Byron Bird, Warren E. Stewart and Edwin N Lightfoot; John Wiley & Sons.
2. Fundamentals of Momentum, Heat and Mass Transfer, 4th Edition: James R. Welty, Charles E. Wicks, Robert E. Wilson and Gregory Rorrer; John Wiley & Sons.

Reference Books:

1. Transport phenomena in materials processing : D.R. Poirier and G.H. Geiger, TMS.
2. Introduction to Fluid Mechanics, 5th Edition: Robert W. Fox & Alan T. McDonald: John Wiley & Sons.

Course Outcomes:

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

1. Pose a problem in transport phenomena as a balance equation.
2. Make suitable assumptions to make the problem a well defined one.
3. Identify suitable geometry and boundary conditions for the problem.
4. Solve simple partial differential equations relevant to transport phenomena.
5. Plot different parameters and interpret the solutions.
6. Understand the concept of heat transfer, fluid flow and mass transfer.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Met. Engg. II-Semester **L T P C**
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MAJOR PROJECT (PHASE-II)

Pre- Requisites: Nil

Course Objectives:

1. This course is mainly intended to make the students acquire real time practical experience on the industry oriented processes, technologies, and applications once again.
2. Students will be exposed to sophisticated equipments and modern technologies.

Course Outcomes:

At the end of the course the student will be able to:

1. Identify a research problem after thorough literature review in metallurgical engineering, plan and execute experimental work to obtain results.
2. Further analyze the results, prepare a technical report and make a presentation.