JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in METALLURGICAL AND MATERIALS ENGINEERING
COURSE STRUCTURE & SYLLABUS (R18)

Applicable From 2018-19 Admitted Batch

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA301BS	Probability and Statistics & Complex Variables	3	1	0	4
2	MM302PC	Mineral Processing	3	0	0	3
3	MM303PC	Introduction to Transport Phenomenon	3	0	0	3
4	MM304PC	Physical Metallurgy	3	1	0	4
5	MM305PC	Materials Thermodynamics	3	0	0	3
6	MM306PC	Mineral Processing Lab	0	0	3	1.5
7	MM307PC	Metallography Lab	0	0	2	1
8	MM308PC	Materials Chemistry Lab	0	0	3	1.5
9	*MC309	Constitution of India	3	0	0	0
		Total Credits	**18**	**2**	**8**	**21**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MM401PC	Principles of Extractive Metallurgy	3	0	0	3
2	EE401ES	Basic Electrical and Electronics Engineering	3	1	0	4
3	MM403PC	Mechanical Metallurgy	3	0	0	3
4	MM404PC	Phase Transformations	3	0	0	3
5	MM405PC	Iron and Steel Making	4	0	0	4
6	EE409ES	Basic Electrical and Electronics Engineering Lab	0	0	2	1
7	MM407PC	Mechanical Metallurgy Lab	0	0	3	1.5
8	MM408PC	Phase Transformations Lab	0	0	3	1.5
9	*MC409	Gender Sensitization Lab	0	0	2	0
		Total Credits	**16**	**1**	**10**	**21**

***MC – Satisfactory/Unsatisfactory**

MA301BS: PROBABILITY AND STATISTICS & COMPLEX VARIABLES

B.Tech. II Year I Sem.	L	T/P/D	C
	3	1/0/0	4

Pre-requisites: Mathematical Knowledge at pre-university level

Course Objectives: To learn

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

Course outcomes: After learning the contents of this paper the student must be able to

- Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.
- Analyse the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
- Taylor's and Laurent's series expansions of complex function.

UNIT - I: Basic Probability **8 L**

Probability spaces, conditional probability, independent events, and Bayes' theorem.
Random variables: Discrete and continuous random variables, Expectation of Random Variables, Moments, Variance of random variables

UNIT - II: Probability distributions **10 L**

Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution
Continuous random variables and their properties, distribution functions and density functions, Normal and exponential, evaluation of statistical parameters for these distributions

UNIT - III: Testing of Hypothesis **10 L**

Test of significance: Basic of testing of Hypothesis. Null and alternate Hypothesis, types of errors, level of significance, critical region.
Large sample test for single proportion, difference of proportions, single mean, difference of means; small sample tests: Test for single mean, difference of means and test for ratio of variances

UNIT - IV: Complex Variables (Differentiation) **10 L**

Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT - V: Complex Variables (Integration) **10 L**

Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

REFERENCES:

1. Fundamentals of Mathematical Statistics, Khanna Publications, S. C. Gupta and V. K. Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, 8th Edition, Pearson Educations
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

MM302PC: MINERAL PROCESSING

II B.Tech. (MME) I - Semester

L	T	P	C
3	0	0	3

Course Objectives:
The prime objective of this course is to build the solid foundation on principals and equipment of various mineral beneficiations procedures that would facilitate metal extraction. It also focuses on mathematical derivations that are associated with concentration processes.

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

- Understand the importance of mineral processing technology.
- Understand techniques of mineral processing for concentration of ore minerals economically.
- Review environment friendly techniques for concentration of sulphide minerals.
- Compute the recovery of ore mineral after concentration.

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; Grinding - Types of grinding operations like Batch and Continuous grinding, Dry and Wet grinding, 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: Study of laboratory sizing techniques and reporting of sizing data; Industrial sizing units - Types of screen surfaces, Grizzlies, Trommels, Vibrating and Shaking screens; Movement of solids in fluids – Stokes' and Newton's laws, Terminal velocity and its relation with size, Relation between time and velocity, Relation between distance travelled and velocity; Equal settling ratio, Free and hindered settling ratios; Quantifying concentrating operations - Ratio of concentration, Recovery, Selectivity Index and Economic Recovery; Classification – Types of classifiers, Study of Settling Cones, Rake Classifier, Spiral Classifier and Cyclones.

UNIT - III
Heavy Media Separation - Principles, flow chart, different media used, Heavy Media Separation using heavy liquids and heavy suspensions, Washability curves for easy, normal and difficult coal; Magnetic separation processes and Electrostatic separation process.

UNIT - IV
Jigging: - Theory of jigging, jigging machines - Harz jig, Denver jig Baum jig, Hancock jig, James coal jig and Halkyln jig, Design considerations in a jig. Tabling - Study of stratification on a table. Shaking tables, Wilfley table.

UNIT - V
Flotation - Principles of flotation, Factors affecting flotation, Classification of Collectors and Frothers, Regulators, and Factors affecting their efficiency, Application of flotation process for Cu, Pb and Zn ores.

TEXT BOOKS:
1. Mineral processing technology - B. A. Wills
2. Principles of Mineral Dressing - A.M. Gaudin

REFERENCE BOOKS:
1. Ore dressing Practices - S. K. Jain
2. Elements of Ore Dressing - A. F. Taggart

MM303PC: INTRODUCTION TO TRANSPORT PHENOMENON

II B.Tech.(MME) I Sem.

L	T	P	C
3	0	0	3

Course objectives:
This course will introduce the concepts of fluid flow, heat transfer and mass transfer with behavior and processing of engineering materials as the focus.

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

- Pose a problem in transport phenomena as a balance equation
- Make suitable assumptions to make the problem a well defined one
- Identify suitable geometry and boundary conditions for the problem
- Solve simple partial differential equations relevant to transport phenomena
- Plot different parameters and interpret the solutions

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.

MM304PC: PHYSICAL METALLURGY

II B.Tech.(MME) I Sem.

L	T	P	C
3	1	0	4

Course objectives:

- To learn about the principles of alloy design, phase diagram and strengthening mechanisms in different metals and alloys.
- To study the fundamental aspects of heat treatment and its influence on properties and applications
- To obtain knowledge about the physical metallurgy of specific and important engineering materials such as ferrous and non-ferrous alloys

Course Outcomes: By completing this course the student will have:

- The ability to identify the concepts of alloy design, phase diagrams and strengthening mechanisms and apply them to materials systems
- The knowledge of heat treatment and the resulting microstructure in materials
- The knowledge of physical metallurgical aspects of important engineering alloys

UNIT - I

Phase diagrams: binary and ternary, principles of alloying, Hume-Rothery rules. Strengthening mechanisms, solid solution, work hardening, precipitation hardening, dispersion strengthening.

UNIT - II

Iron carbon diagram, isothermal, and continuous cooling transformation diagrams; influence of alloying elements on transformation characteristics.

UNIT - III

Heat treatment - annealing, normalizing, hardening and tempering of steels, hardenability

UNIT - IV

Introduction to important ferrous alloys, stainless steels, special steels, cast irons, aluminium alloys.

UNIT - V

Titanium alloys, copper base alloys. Superalloys, shape memory alloys – classification, heat treatment, properties and applications.

TEXT BOOKS:

1. Physical Metallurgy: Principles and Practice, V. Raghavan, PHI Learning, Delhi, 2008.
2. Physical Metallurgy Principles, R. Abbaschian, R. E. Reed-Hill, Cengage Learning, 2009

REFERENCE BOOKS:

1. Physical Metallurgy Vols. I, II, III, R.W. Cahn and P. Haasen, North Holland, 1996.
2. Light Metals, I.J. Polmear, Elsevier, 2005

MM305PC: MATERIALS THERMODYNAMICS

II B.Tech.(MME) I Sem.

L	T	P	C
3	0	0	3

Course objectives:

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

Course Outcomes: After completing this course, the student should be able to:

- Use the various thermodynamic functions appropriately under different experimental situations involving gases, liquids and solids
- Derive and explain the Gibbs Phase rule
- Utilize Ellingham diagrams Utilize Pourbaix diagrams

UNIT - I

Objectives and Limitations of Thermodynamics, concepts of system and state, heterogeneous and homogeneous systems, gases: Ideal gas, Real gas, Van-der Waals; extensive and intensive properties, of system, thermodynamic variables, thermodynamic equilibrium. Reversible and irreversible processes. First Law of Thermodynamics: Nature of first law, relationship between heat and work, internal energy and the first law of thermodynamics, calculations of work,, enthalpy change with temperature, Kirchhoff's equation.

UNIT - II

Second Law of Thermodynamics: Efficiency of a cyclic process, Carnot cycle, Carnot theorem, second law of thermodynamics, concept of entropy, entropy and quantification of irreversibility, reversible processes. Third law of thermodynamics: Background of third law, deductions from third law, applications of third law, and other methods of obtaining $\Delta S0$ for a reaction. Statistical interpretation of entropy, Boltzmann equation.

UNI - III

Energy Functions: Purposes of the new functions, definition of Helmholtz and Gibbs energy change, meaning of thermodynamically possible process, determination of ΔG from thermal data useful relationships among thermodynamic functions, Maxwell's equations and Gibbs-Helmholtz equation. Fugacity, activity and equilibrium constant: Concepts of fugacity, activity and equilibrium constant variation of the equilibrium constant with temperature. Application of the Clausius – Clapeyron equation for single substance, Duhringes rule for the estimation of the vapor pressures of an element, Integration of Clausius – Clapeyron equation.

UNIT - IV

Solutions: Composition, Concept of chemical potentia, partial molal quantities, Gibb's - Duhem equation, integration of Gibbs' - Duhem equation, ideal dilute solutions, ideal solutions, Raoults Law, actual (Non-ideal) solutions (Henry's Law), Sieverts law, Excess thermodynamics quantities.

UNIT - V

Application of Ellingham diagrams to process metallurgy: Introduction, calculation of equilibrium constants from standard energy changes, general description of Ellingham diagrams, Interpretation of two or more free energy change vs. temperature lines taken together, derivation and uses of the oxygen, nomographic scale in Richardson's diagrams.

TEXT BOOKS:

1. Introduction to Thermodynamics of Materials, 5th Edition, David R Gaskell, Taylor and Francis, 2016.
2. Materials Thermodynamics with Emphasis on Chemical Approach, Hae-Geon Lee, World Scientific Publishing, 2012.

REFERENCE BOOKS:

1. Thermodynamics in Materials Science, Robert De-Hoff, CRC Press, 2006.
2. Principles of Metallurgical Thermodynamics/ SK Bose and SK Roy; Editor-in- Chief, Baldev Raj. Published by Universities Press (India) Private Limited, 2014.

MM306PC: MINERAL PROCESSING LAB

II B.Tech. (MME) I -Sem.

L	T	P	C
0	0	3	1.5

Course objectives:
This laboratory course is designed to make the student to understand and demonstrate the process variables in mineral processing techniques employed. The mineral characteristics like size and size distribution etc. also evaluated.

Course outcomes: The student would gain hands on experience on

- Particle size and its distribution in a given material.
- Determination of reduction ration in crushing and grinding machines.
- To have an understanding on magnetic separation of magnetic ores from non magnetic.
- To understand about different ore characteristics and various industrial mineral processing operations for beneficiation.

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

List of equipment:
1. Riffle Sampler, ,2. Sieve Shaker with Sieves 3. Stokes' Apparatus, 4. Jaw Crusher, 5. Roll Crusher, 6. Ball Mill, 7. Grindability Index Apparatus, 8. Magnetic Separator, 9. Jig, 10. Wilfly's Table, 11. Froth – Floatation Equipment, 12. Balances

MM307PC: METALLOGRAPHY LAB

II B.Tech. (MME) I Sem.

L	T	P	C
0	0	2	1

Course objectives:
To provide hands on experience to prepare the samples for metallographic analysis and understand the basic constituents of microstructures.

Course Outcomes: By completing this laboratory course, students will :

- Get to know and gain hands on experience with various techniques of sample preparation for metallographic analysis of metals and alloys
- Be able to analyse the hardness of different constituents of microstructure using different hardness testers
- Obtain knowledge of quantitative analysis, such as grain size, volume fraction of second phases.

List of experiments:

1. Study of metallurgical microscope
2. Metallographic preparation of metals and alloys
3. Microscopic examination and microstructure interpretation of steels
4. Microscopic examination and microstructure interpretation of nonferrous metals
5. Microscopic examination and microstructure interpretation of heat treated steels
6. Microscopic examination and microstructure interpretation of cast structures
7. Microscopic examination and microstructure interpretation of wrought structures
8. Microscopic examination and microstructure interpretation of welded structures
9. Microscopic examination of defects and failures in components
10. Conduct of Hardness testing of metals on Vickers scale

List of equipment:

1. Metallurgical microscopes, 2. Belt grinders, 3. Disc polishers, 4 Vickers Hardness tester
5. Metallographic Samples (Ferrous and Non-Ferrous)

TEXT Books:

1. R. Haynes, 1984, Springer science + Business Media, New York
2. Douglas B. Murphy, 2001, Wiley-Liss, Inc. USA

MM308PC: MATERIALS CHEMISTRY LAB

II B.Tech.(MME) I Sem.

L	T	P	C
0	0	3	1.5

Course objectives:

This course introduces chemical analysis of metallic alloys using laboratory practice.

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

- Identify the major elements in a metallic alloy using chemical methods
- Quantify specific elements in ferrous and non-ferrous alloys using titration
- Interpret the results from different spectroscopy instruments to determine chemical composition

List of experiments:

1. Identification of metallic and non-metallic ions in the given substance by wet chemical methods.
2. Estimation of Iron in Iron ore by $KMnO_4$ and $K_2Cr_2O_7$methods.
3. Estimation of Silicon in Cast Iron by chemical method.
4. Estimation of Manganese in Ferro-alloys by spectrophotometer.
5. Estimation of Sodium and Potassium in Chloride Salts by Flame Photometry.
6. Estimation of Copper in Brass by Electrochemical Analyzer.
7. Estimation of concentration of $KMnO_4$in the solution using colorimeter.
8. Determination of viscosity of a given fluid by Viscometers (Redwood -I, Redwood – II and Saybolt viscometer).
9. Determination of calorific value of Solid and liquid fuels.

List of Equipment:

1. Flame Photometer, 2. Spectrophotometer. 3. Electrochemical Analyzer. 4. Colorimeters.
5. Chemicals and Glassware. 6. Redwood and Saybolt viscometers. 7 Junker's gas calorimeter,
8. Bomb Calorimeter

TEXT BOOKS:

1. A text book of metallurgical analysis, B C Aggarwal, Khanna Publishers(2002)
2. Corrosion Engineering, Mars Fontana, McGraw Hill(2017)

REFERENCE BOOKS:

1. Instrumental methods of analysis, Willard, CBS Publishers & Distributors (2004)
2. Transport phenomena, B. Bird, W.E. Stewart and E.N. Lightfoot, John Wiley & Sons (2007)

*MC309/*MC409: CONSTITUTION OF INDIA

B.Tech. II Year I Sem.

L	T/P/D	C
3	0/0/0	0

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India’s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be “static” and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it “as one of the strongest court in the world”.

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

MM401PC: PRINCIPLES OF EXTRACTIVE METALLURGY

II B.Tech. (MME) II Semester

L	T	P	C
3	0	0	3

Course objectives:

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

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

- List out ore minerals for ferrous and non-ferrous metals.
- Discuss the principles of fire refining, liquation, distillation refining and zone refining.
- Examine the importance of slag chemistry in the extraction process.
- Recognize the importance of Ellingham diagrams and criteria required for reduction of metals.

UNIT - I

Introduction: Classification of ores. Basics of Pyrometallurgy, Calcination, Roasting and types of roasting.

UNIT - II

Sintering pelletisation and Smelting: Basic Principles with examples. Slags: Classification, properties and uses.

UNIT - III

Hydrometallurgy: Advantages and disadvantages. Flowchart. Principles and types of leaching. Solution purification by ion and solvent exchange. cementation.

UNIT - IV

Principles of electrometallurgy: Electro winning and Electro refining with typical examples.

UNIT - V

Fire refining, Distillation, liquation, 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-Gosh

REFERENCE Books:

1. A text book of Metallurgy-A.R.Bailey.

EE401ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

II B.Tech. (MME) II Semester

L	T	P	C
3	1	0	4

Course Objectives:

- To introduce the concepts of electrical circuits and its components
- To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- To study and understand the different types of DC/AC machines and Transformers.
- To import the knowledge of various electrical installations.
- To introduce the concept of power, power factor and its improvement.
- To introduce the concepts of diodes & transistors, and
- To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:

- To analyze and solve electrical circuits using network laws and theorems.
- To understand and analyze basic Electric and Magnetic circuits
- To study the working principles of Electrical Machines
- To introduce components of Low Voltage Electrical Installations
- To identify and characterize diodes and various types of transistors.

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.

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, Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT - II:

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.

UNIT - III:

ELECTRICAL MACHINES

Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three-phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three-phase Induction motor, Torques equations and Speed control of Three-phase induction motor. Construction and working principle of synchronous generators.

UNIT - IV:

P-N JUNCTION AND ZENER DIODE: Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications.

RECTIFIERS AND FILTERS: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

UNIT - V:

BIPOLAR JUNCTION TRANSISTOR (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations.

FIELD EFFECT TRANSISTOR (FET): Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

TEXT BOOKS:

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

REFERENCES:

1. Electronic Devices and Circuits – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
7. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
8. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
9. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

MM403PC: MECHANICAL METALLURGY

II B.Tech.(MME) II Sem.

L	T	P	C
3	0	0	3

Course objectives:

- To obtain knowledge of stress response of materials, load bearing ability, elastic and plastic deformation.
- To obtain insight about different mechanical properties of materials under engineering applications.

Course outcomes: After completing this course, students will be able:

- To explain how elastic and plastic deformations as events taking place at atomic and crystal levels
- To understand the concept of plastic deformation and the role of dislocations in plastic deformation of materials
- To explain the mechanisms of fatigue and creep failures in materials
- To discuss strengthening mechanisms in metals as well as failure analysis methods
- To understand the load bearing ability of different materials and their response to stress under engineering applications.

UNIT - I

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

UNIT - II

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

UNIT - III

Tension Test: Engineering stress and Engineering strain, True stress-strain curve. Tension Test and tensile properties, conditions for necking, effect of temperature and strain rate on tensile properties. Compression Test, Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, significance of transition temperature curve, Metallurgical factors affecting the transition temperature, temper embrittlement. DBTT curve and its importance. Fracture toughness testing - COD and CTOD tests.

UNIT - IV

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

UNIT - 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 by George E Dieter, McGraw-Hill Education; 3 edition June 1986
2. Mechanical Behaviour of Materials, Thomas H Courtney, McGraw-Hill Education;2 revised edition

REFERENCE BOOKS:

1. Mechanical Behaviour of Materials, Marc Andre Meyers and Krishnan Kumar Chawla, Cambridge University Press, 2 edition
2. Mechanical Metallurgy - White & Le May

MM404PC: PHASE TRANSFORMATIONS

II B.Tech.(MME) II Sem.

L	T	P	C
3	0	0	3

Course objectives:
To introduce the student to key concepts in Phase transformations and enable an understanding of the steps involved in several important phase transformations.

Course outcomes: After completing this course, the student should be able to:

- Classify phase transformations
- Indicate important steps in different types of phase transformations
- Explain phase transformations from the perspective of thermodynamics and kinetics
- Describe a few well known and studied phase transformations

UNIT - I
Definition and types of Phase transformations, Diffusion: Fick's laws of diffusion, solution of Fick's second law and its applications, atomic model of diffusion and role of crystal defects, temperature dependence of diffusion coefficient.

UNIT – II
Kirkendall effect. Diffusional transformation in solids and diffusionless transformation in solids. Nucleation and growth, energy considerations; homogeneous nucleation, heterogeneous nucleation, growth kinetics, overall transformation rates.

UNIT - III
Crystal interfaces and microstructure. Microstructure evolution, including recrystallization and grain growth. Precipitation from solid solution: Homogeneous and hetrogeneous nucleation of precipitates, the aging curve, mechanisms of age hardening, examples from Al-Cu and other alloy systems.

UNIT - IV
Martensitic Transformations: General characteristics of martensitic reactions, similarity to deformation twinning, bain distortion, crystallography and kinetics of martensitic transformations, examples from ferrous and non-ferrous alloy systems.

UNIT - V
Order-disorder Transformation Examples of ordered structures, long and short range order, detection of super lattices, influence of ordering on properties. Spinodal decomposition.

TEXT Books:

1. Solid State Phase Transformations, V. Raghavan, Prentice Hall India Learning Private Limited, 1987.
2. Phase Transformations in Metals and Alloys, David A. Porter and Kenneth E. Easterling, Third Edition, CRC Press, 2017

REFERENCE Books:

1. Physical Metallurgy Principles, Reza Abbaschian, Lara Abbaschian, and Robert E. Reed- Hill, Cengage, 2013
2. Mechanisms of Diffusional Phase Transformations in Metals and Alloys,Hubert I. Aaronson, Masato Enomoto, and Jong K. Lee, CRC Press, 2016.

MM405PC: IRON AND STEEL MAKING

II B.Tech.(MME) II Sem.

L	T	P	C
4	0	0	4

Course objectives:

- To provide the knowledge of Iron making by Blast Furnace, Physio- chemical principles involved in iron making.
- To understand and demonstrate the various types of steel making processes, Hot metal route and scrap route.

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

- Describe the physical and chemical processes that take place during iron making and steelmaking
- Analyses the effect of change in process parameters in iron making and steelmaking processes
- Describe the methods for control of quality in iron and steel production

UNIT - I

Principles of Iron making, Raw materials for Iron making, Preparation of iron ores; Agglomeration of Iron ore fines: Sintering and Pelletisation, Principles, Factors affecting sintering, sintering bonds; Theory of Pelletisation, Water-particles system. 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, burden distribution. 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 Slags and its properties. 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. Extractive Metallurgy 2: Metallurgical Reaction Processes, Alain Vignes (ISTE Ltd.,)
2. Extractive Metallurgy 3: Processing Operations and Routes, Alain Vignes (ISTE Ltd.,)
3. An introduction to modern steel making, R. H. Tupkary, Khanna Publishers (2000)
4. An introduction to modern iron making, R. H. Tupkary, Khanna Publishers (2004)

EE409ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

II B.Tech.(MME) II Sem.

L	T	P	C
0	0	2	1

Pre-requisites: Basic Electrical and Electronics Engineering

Course Objectives:

- To introduce the concepts of electrical circuits and its components
- To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- To study and understand the different types of DC/AC machines and Transformers.
- To import the knowledge of various electrical installations.
- To introduce the concept of power, power factor and its improvement.
- To introduce the concepts of diodes & transistors, and
- To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:

- To analyze and solve electrical circuits using network laws and theorems.
- To understand and analyze basic Electric and Magnetic circuits
- To study the working principles of Electrical Machines
- To introduce components of Low Voltage Electrical Installations
- To identify and characterize diodes and various types of transistors.

List of experiments/demonstrations:

PART A: ELECTRICAL

1. Verification of KVL and KCL
2. (i) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
   (ii) Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star) in a Three Phase Transformer
3. Measurement of Active and Reactive Power in a balanced Three-phase circuit
4. Performance Characteristics of a Separately Excited DC Shunt Motor
5. Performance Characteristics of a Three-phase Induction Motor
6. No-Load Characteristics of a Three-phase Alternator

PART B: ELECTRONICS

1. Study and operation of
   (i) Multi-meters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
2. PN Junction diode characteristics
3. Zener diode characteristics and Zener as voltage Regulator
4. Input & Output characteristics of Transistor in CB / CE configuration
5. Full Wave Rectifier with & without filters
6. Input and Output characteristics of FET in CS configuration

TEXT BOOKS:

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

REFERENCES:

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.

3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
7. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
8. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
9. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

MM407PC: MECHANICAL METALLURGY LAB

II B.Tech.(MME) II Semester

L	T	P	C
0	0	3	1.5

Course objectives:

To obtain knowledge on various mechanical testing machines, and mechanical testing methodology.

Course Outcomes: After completing the course, the student will be able

- To extract and interpret sensible information from mechanical test data.
- To give explanation on relationships between metallurgy of the metals and their mechanical properties.
- To perform mechanical testing of metals (Hardness, tension and Impact)
- To select metals for engineering applications.
- To design metals for engineering applications.

List of experiments:

1. To determine the Brinell Hardness of ferrous and non-ferrous samples.
2. To determine the Rockwell hardness of ferrous and non-ferrous samples.
3. To determine the hardness of ferrous and non-ferrous samples by using Vickers hardness tester.
4. To Determination of hardness profile across weldments
5. To determine the elastic modulus, ultimate tensile strength, breaking stress, percentage
6. elongation percentage reduction in area of the given specimen by tensile test.
7. To plot True stress Vs True stain and compare with engineering stress strain curve by tensile test.
8. To determine the modulus of rigidity of given material by torsion test
9. To determine the Charpy and Izod (V & U Groove notch) impact strength of a given material at room temperature.
10. To determine the fatigue strength of given material at a given stress

List of equipment:

1. Brinell Hardness Machine 2. Vickers Hardness Machine 3. Rockwell Hardness Machine 4. UTM, 5. Torsion Testing Machine 6. Impact Testing Machine 7. Fatigue Testing Machine

TEXT Books:

1. Appropriate ASTM standards to be followed to understand associated theory.
2. Mechanical Metallurgy by George E Dieter, McGraw-Hill Education; 3rd edition June 1986

MM408PC: PHASE TRANSFORMATIONS LAB

II B.Tech.(MME) II Sem.

L	T	P	C
0	0	3	1.5

Course Objective:

This Laboratory course is designed to make the student understand and demonstrate the various types of heat treatment processes, process variables and surface hardening treatments for ferrous and non-ferrous metals and alloys.

Course outcomes: The student would gain hands on experience

- To define heat treatment cycles for ferrous and non-ferrous metals and alloys with proper
- understanding of different heat treatment process variables.
- To evaluate the microstructure and hardness after successful heat treatment.

List of Experiments:

1. Annealing of plain carbon steel and observation of hardness and microstructure
2. Normalizing of plain carbon steel and observation of hardness and microstructure
3. Hardening of plain carbon steel and observation of hardness and microstructure
4. Study of tempering characteristics of hardened steel.
5. Study of age hardening phenomenon in an Al-Cu alloy or Cu-Be alloy
6. Spheroidizing of high carbon steel
7. Determination of hardenability of a steel using Jominy End Quench Test
8. Re-crystallization studies on cold worked Cu or Cu alloys

Equipment:

1. Muffle Furnaces 1200 ^{0}C, 2. Jominy End Quench Apparatus, 3. Microscopes,
4. Rockwell Hardness Tester

***MC409/*MC309: GENDER SENSITIZATION LAB**

(An Activity-based Course)

B.Tech. II Year II Sem.	**L**	**T/P/D**	**C**
	0	**0/2/0**	**0**

COURSE DESCRIPTION

This course offers an introduction to Gender Studies, an interdisciplinary field that asks critical questions about the meanings of sex and gender in society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary. It draws on multiple disciplines – such as literature, history, economics, psychology, sociology, philosophy, political science, anthropology and media studies – to examine cultural assumptions about sex, gender, and sexuality.

This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities. This course also seeks to build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination. The course also features several exercises and reflective activities designed to examine the concepts of gender, gender-based violence, sexuality, and rights. It will further explore the impact of gender-based violence on education, health and development.

Objectives of the Course:

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

Learning Outcomes:

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.
- Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT - I: UNDERSTANDING GENDER

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men

- Preparing for Womanhood. Growing up Male. First lessons in Caste.

UNIT – II: GENDER ROLES AND RELATIONS

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences-Declining Sex Ratio. Demographic Consequences-Gender Spectrum: Beyond the Binary

UNIT – III: GENDER AND LABOUR

Division and Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

UNIT – IV: GENDER - BASED VIOLENCE

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No! -Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu".*

Domestic Violence: Speaking OutIs Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for my Life…."

UNIT – V: GENDER AND CULTURE

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals

Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks-The Brave Heart.

Note: **Since it is Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.**

- ***Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments. Apart from the above prescribed book, Teachers can make use of any authentic materials related to the topics given in the syllabus on "Gender".***

- **ESSENTIAL READING**: The Textbook, "*Towards a World of Equals: A Bilingual Textbook on Gender" written* by A.Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu **published by Telugu Akademi, Telangana Government in 2015.**

ASSESSMENT AND GRADING:

- Discussion & Classroom Participation: 20%
- Project/Assignment: 30%
- End Term Exam: 50%