JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.TECH. METALLURGICAL AND MATERIALS ENGINEERING
III YEAR COURSE STRUCTURE & SYLLABUS (R16)

Applicable From 2016-17 Admitted Batch

III YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	MM501PC	Heat Treatment	4	0	0	4
2	MM502PC	Iron Making	4	0	0	4
3	MM503PC	Mechanical Working	4	0	0	4
4	SM504MS	Fundamentals of Management	3	0	0	3
5		Open Elective – I	3	0	0	3
6	MM505PC	Heat Treatment Lab	0	0	3	2
7	MM506PC	Mechanical Working Lab	0	0	3	2
8	MM507PC	Basic Metallurgical Computations Lab	0	0	3	2
9	*MC500HS	Professional Ethics	3	0	0	0
		Total Credits	**21**	**0**	**9**	**24**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	MM601PC	Steel Making	4	0	0	4
2	MM602PC	Welding Metallurgy	4	0	0	4
3	MM603PC	Foundry Technology	4	0	0	4
4		Open Elective – II	3	0	0	3
5		Professional Elective - I	3	0	0	3
6	MM604PC	Welding Metallurgy Lab	0	0	3	2
7	MM605PC	Foundry Technology Lab	0	0	3	2
8	EN606HS	Advanced English Communication Skills Lab	0	0	3	2
		Total Credits	**18**	**0**	**9**	**24**

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

Professional Elective – I

MM611PE	Non Ferrous Extractive Metallurgy
MM612PE	Surface Engineering
MM613PE	Electronic and Magnetic Materials

***Open Elective** subjects' syllabus is provided in a separate document.

***Open Elective –** Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

Ex: - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

HEAT TREATMENT

	L	T	P	C
B.Tech. III Year I Sem.				
Course Code: MM501PC	**4**	**0**	**0**	**4**

Course Objective

This course is mainly focused to develop knowledge among the students about the basic practices and process variables of heat treatment. Thermo-mechanical treatment, surface hardening techniques, heat treatment of steels, non ferrous alloys

Course Outcome: end of the course student is in a position to, know how to approach the problem of choosing an alloy for a particular application and know how to approach the design of a heat treatment for an alloy for a particular application.

UNIT-I

Annealing, Normalizing, Hardening, Mechanism of heat removal during quenching, quenching media, sixe and mass effect, Tempering and its stages

UNIT-II

Time Temperature Transformation (TTT) and CCT Curves, effect of cooling on transformation of Austenitic, perarlitic, bainite, and martensite.

UNIT-III

Effect of alloying elements on Fe-C system and TTT curves, Hardenability of Steels, Factors affecting and its determination

UNIT-IV

Thermo-mechanical treatments, Austempering, Martempering, Patenting, Spheoridizing, Ausforming strain tempers, Subzero treatment, Isoforming, Cryoforming

UNIT-V

Surface Hardenting: Carburizing, Nitriding, Cyaniding, Carbonitiriding, Induction and Flame Hardening. Heat treatment of Cast Irons, Carbon Steels and Alloy Steels, Maraging Steels, and Al- Alloys

TEXT BOOK:

1. Heat Treatment Principle and Techniques - Rajan & Sharma
2. Heat Treatment of Metals – Zakharov, Mir Publishers, Moscow

REFERENCES:

1. Engineering Physical Metallurgy and Heat Treatment by Yu. Lakhtin
2. Physical Metallurgy Principles – Reza Abbaschian, Lara Abbaschian and Robert E. Reed-Hill.

IRON MAKING

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MM502PC	**4**	**0**	**0**	**4**

Course Objective:

The course objective is to provide the knowledge of Iron making by Blast Furnace, Physio-chemical principles involved in iron making, recent advances. Necessity and advantages of alternative routes of iron making.

Outcome:

The student will be in a position to understand the process of Iron Making in detail, there by he/she would be understanding the process variables to enhance the productivity and efficiency of the Blast Furnace and alternative routes of Iron Making.

UNIT-I

History of Iron making, valuation of iron ores and classification of iron ores, Principles of Iron making, Reduction, Smelting, Direct Reduction, Smelt Reduction; Raw materials for Iron making, their distribution, occurrence in India and in the world.

UNIT-II

Preparation of iron ores; Agglomeration of Iron ore fines, Sintering; Principles, Factors affecting sintering, sintering bonds, sintering machines; Pelletisation; Theory of Pelletisation, Water-particles system. Production of green pellets in; disk and drum pelletizers, Induration of pellets, Shaft, traveling grate and continues grate kiln machine.

UNIT-III

Blast Furnace profile and its design, Refractory lining. Water cooling system. Raw materials handling and charging, Burden distribution, Construction and operation of Hot blast Stoves. Gas cleaning system and its utilization

UNIT-IV

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. Types of Pig Irons & Blast furnace Slags and its properties. Blast furnace operations and difficulties, Modern Trends in Blast furnace; Burden calculations, Limitations of Blast furnace Iron production,;

UNIT-V

Alternate Routes of Iron Making, Principles of Sponge Iron Making, Degree of Metallization, Percentage Reduction, Classification of Sponge Iron making methods. Using gases reducing agent, process as Midrex , HY and Krupp-Renn, Using solid reducing agent process such as SL/RN process, Smelt Reduction Methods; COREX, INRED, ELRED, Plasma Smelting; Sponge Iron making in India.

TEXT BOOKS:

1. Principles of Blast furnace Iron making – A.K Biswas
2. Beyond Blast furnace – Amit Chaterjee – CRC Press
3. Modern Iron Making – Dr. R. H. Tupkary

REFERENCES:

1. Iron making and Steel making – Ahindra Ghosh & Amit Chaterjee PMI Pvt. Ltd. 2008
2. Hand Book of Extractive Metallurgy – Fathi Habhashi Vol. 1 Metals Industry Ferrous Metals

MECHANICAL WORKING

	L	T	P	C
B.Tech. III Year I Sem.				
Course Code: MM503PC	**4**	**0**	**0**	**4**

Course Objective: This course is mainly designed to provide knowledge about various metal forming operations, their process parameters, and mathematical equations associated with the process.

Course Outcome: The student will be able to solve problems on calculation of required stress, extent of deformation in metal forming techniques.

UNIT-I

Stress and Strain Relationship for Elastic Behavior: Description of stress at a point. State of stress in two dimensions.Mohrs 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.

UNIT-II

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-III

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

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,.

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

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.

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

TEXT BOOKS:

1. Mechanical Metallurgy by GE Dieter (3rd edition)
2. Technology of Metal Forming Processes – Surender Kumar PHI 2008

REFERENCES:

1. Mechanical Working of Metals - Avitzur.
2. Engineering Metallurgy – Part II - Higgins.
3. Mechanical Metallurgy - White and Lemay.

FUNDAMENTALS OF MANAGEMENT

	L	T	P	C
B.Tech. III Year I Sem.				
Course Code: SM504MS	**3**	**0**	**0**	**3**

Course Objective: To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills.

Course Outcome: The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation and Control aspects are learnt in this course. The students can explore the Management Practices in their domain area.

UNIT-I

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.

UNIT-II

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving - Programmed and Non Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

UNIT-III

Organization and HRM: Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization; Organizational Culture; Organizational Climate and Organizational Change.

Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT-IV

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Leadership.

Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT-V

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency and Methods.

Text Books:

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

References:

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.

HEAT TREATMENT LAB

	L	T	P	C
B.Tech. III Year I Sem.				
Course Code: MM505PC	**0**	**0**	**3**	**2**

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 Outcome: 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.

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. Hardenability Apparatus
3. Microscopes
4. Rockwell Hardness Tester

MECHANICAL WORKING LAB

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MM506PC	**0**	**0**	**3**	**2**

Course Objective

This lab course is mainly designed to know the various testing methods for evaluation of metal forming techniques.

Course Outcome

Upon successful completion of this course, the student will be able to understand various deformation processes in materials.

LIST OF EXPERIMENTS

1. To determine the formability of given materials by Erichson cup test
2. To manufacture washer components using fly press (progressive dies /compound dies)
3. Deep drawing of a cup with / without blank holder by hydraulic press
4. To determine the friction factor by ring compression test
5. Determination of strain hardening exponent ‘n’ and strength coefficient ‘k’
6. To verify hall petch relation in MS specimen

EQUIPMENT

1. UTM
2. Hydraulic press
3. Fly press
4. Erichson cup

BASIC METALLURGICAL COMPUTATIONS LAB

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MM507PC	**0**	**0**	**3**	**2**

LIST OF EXPERIMENTS: Programming of

1. Estimation of proportion of phases using Lever rule
2. Determination of ASTM grain size
3. Determination of packing factor for bcc, fcc and hcp
4. Determination of ΔH using Kirchhoff's equation
5. Determination of ΔG from thermal data
6. Determination of Entropy
7. To solve the problems on conductions
8. Hall Petch relation
9. Calculation of UTS and YS

TEXT BOOKS:

1. Computer oriented Numerical methods – V. Rajaraman (PHI Publicatons)
2. Computer programming and Numerical methods – S. Saran
3. Numerical methods in engineering – Mario G. Salvadori and Melvin L. Baron
4. Matrix operation on Computer – L.L. Brirud (LCUE Publication)

PROFESSIONAL ETHICS

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MC500HS	**3**	**0**	**0**	**0**

Course Objective: To enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and Professional lives.

Course Outcome: The students will understand the importance of Values and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen.

UNIT-I

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT-II

Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT-III

Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession.

Central Responsibilities of Engineers - The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walkaway Collapse.

UNIT-IV

Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation.

Ethics in changing domains of research - The US government wide definition of research misconduct, research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing.

UNIT-V

Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual Property Rights.

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

REFERENCES

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard , Michael J Rabins, 4e , Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

STEEL MAKING

B.Tech. III Year II Sem.	L	T	P	C
Course Code: MM601PC	4	0	0	4

Course Objective: This course is primarily of industrial oriented ore and designed to make the student to understand and demonstrate the various types of primary steel making processes, Hot metal route and scrap route, casting pit side practice, Continuous casting of steel and secondary steel making process to produce quality steels.

Course Outcomes: The student would gain knowledge on different primary and secondary steel making processes to produce quality steels with less cost and more efficiently.

UNIT-I

Introduction to Steel Making: Current scenario of steel making in India and world, Raw materials of steel making. Factors affecting the efficiency of steel making.

Principles of Steel making;- Removal of Carbon, Silicon, Manganese, phosphorous and sulphur. Role of slag, types and properties of slags. Molecular and ionic theory of slags. Principles of deoxidation. Precipitation and diffusion deoxidation.

UNIT-II

Primary Steel Making (Hot Metal): Steel making by Acid and Basic Bessemer Processes, Construction and lining details, sequence of elimination of impurities, Steel Making by LD process, Construction, lining and process details in LD, LD-AC or OLP, Kaldo, LD-Kaldo, Rotor oxygen steel making, Oxygen bottom blowing (OBM), Hybrid process of steel making, Improvements and modification of the above steel making process.

UNIT-III

Primary Steel Making (From Scrap): Open Hearth Steel Making: Construction and process details; Electric Arc Furnace (EAF); Construction and Process details: Induction furnace. Stainless steel making.

UNIT-IV

Secondary Steel Making: Secondary steel making processes. Electro Slag Remelting (ESR), Vacuum Arc Remelting (VAR). Brief outline of manufacture of alloy steels. Vacuum treatment of steels. AOD, VOD, Synthetic slag treatments, De-carburization techniques de-gassing of steel Powder injection etc. methods

UNIT-V

Solidification of steels: Ingot defects and remedies; Casting pit side practice: Types of Moulds, Teeming Methods, Killed, Semi Killed, capped and rimmed Steels, Continuous casting of steels.

TEXT BOOKS:

1. Steel Making – V. Kudrin
2. Modern Steelmaking – Dr. R.H. Tupkary and V. H. Tupkary

3. Steel Making – A. K. Chakrabarthi (PHI) 2007

REFERENCES:

1. Iron Making & Steel Making Theory and Practice - Ahindra Ghosh & Amit chatterjee
2. Secondary Steel Making; Principles and applications – Ahindra Ghosh
3. Physical Chemistry of Iron & Steel by Bodsworth.

WELDING METALLURGY

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: MM602PC	**4**	**0**	**0**	**4**

Course Objective: The basic objective of this course is to provide in depth knowledge about various metal joining techniques, the thermal, residual, and transformational stresses associated with, the equipment used, their modern developments, and defects and defectoscopy of weldments.

Course Outcome: The student will be able to apply various metal joining techniques for various ferrous and nonferrous alloys, fixing of process parameters to obtain a sound welding, precautionary measures to be taken to avoid weld defects, and advancements in Metal Joining technologies.

UNIT-I

Classification of welding processes. Principles, advantages disadvantages and fields of application of the following welding processes: Gas Welding, Arc Welding processes, MMAW, GTAW, GMAW, SAW, ESW & EGW, Resistance Welding. Other metal joining techniques: Brazing, Soldering and Adhesive bonding.

UNIT-II

Working principle. Advantages and limitations of solid state welding processes. Friction, friction stir, explosive, diffusion and ultrasonic welding

Advanced Metal Joining Techniques: Plasma Arc Welding, Electron Beam Welding, Laser welding.

UNIT-III

Weldability, Microstructure of fusion zone and heat affected zone. Influence of heat input, thermal and residual stresses, pre heat and cooling rate, PWHT. Weldability of high carbon steel, cast irons, stainless steels use of Schaffler and Delong diagrams.Welding of non-ferrous alloys - Aluminum alloys and Cu-base alloys.

UNIT-IV

Welding of dissimilar metals, Joining of ceramics with case studies.

UNIT-V

Quality Testing of Weldments by Dye Penetrant and Radiography Testing,

Defects in weldments, causes, effects and remedies, hot and cold cracking.

TEXT BOOKS:

1. Welding Technology – R.S. Parmar
2. Welding Technology – O.P. Khanna

REFERENCES:

1. Welding Metallurgy - JF Lancaster
2. Welding and Welding Technology - Little
3. Welding and Metal Fabrication–Larry Jeffres –Yesdee Publishing Pvt. Ltd., 2012

FOUNDRY TECHNOLOGY

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: MM603PC	**4**	**0**	**0**	**4**

Course Objective: This course is mainly intended to introduce and explain various moulding, casting techniques and equipment used. Principles of Solidification of casting, defects in castings and their remedies are also dealt in detail

Course Outcome: This course would pave a platform for students to develop a thorough understanding on the casting technology, solidification of metals and alloys.

UNIT-I

Introduction to Foundry – Types of Foundries and 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. Plaster moulding, 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

UNIT-III:

Melting and Solidification: Cupola and Induction Melting. Nucleation and growth. Freezing of metals and alloys. Dendritic freezing. Progressive and Directional Solidification. Melting of Gray Iron in cupola

UNIT-IV:

Modern Developments: Recently developed processes-V-Forming Full Mould Process, Furon-No-Bake Sand Moulds and Cores, continuous Casting, Cold Setting and Self Setting Processes.

UNIT-V:

Casting Defects and Remedial Measures: Casting defects arising due to moulding, cores, melting and pouring practice. Inspection and Testing of castings

TEXT BOOKS:

1. Principles of Metal casting by Heine – Loper and Rosenthal, Tata Mc Graw Hill, 2nd Edition.
2. Foundry Technology – Dharmendra Kumar & S.K.Jain, CBS Publisher, 2007.

REFERENCES:

1. Fundamentals of Metals Casting, P. C. Mukherjee, Oxford & IBH Pub. Co., 1988
2. Casting Technology and Cast Alloys – AK Chakrabarti – PHI 2011 Edition

NONFERROUS EXTRACTIVE METALLURGY
(Professional Elective - I)

	L	T	P	C
B.Tech. III Year II Sem.				
Course Code: MM611PE	**3**	**0**	**0**	**3**

Course Objective: The main objective of the course is to expose the student to understand basic principles of extraction of important non ferrous metals.

Course Outcome: Student will be in a position to ascertain the method of extraction of a particular metal and also understands the importance of recovery of byproducts during extraction. Upon successful completion of this course, the student will be able to:

- Describe and explain processes and reactors for extraction and refining of metals and alloys
- Explain processes based on an thermodynamic perspective
- Describe and explain material and energy flows related to extraction of metals and alloys
- Describe and explain ore treatment techniques
- Plan and carry out experimental work related to extraction and refining of non ferrous metals

UNIT-I

COPPER: Principal Ores 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: Roasting, Horizontal and vertical retort processes: Production by imperial smelting: Leaching purification: Electrolysis, Refining.

LEAD: Smelting – smelting, Reduction process, Roast Reaction process, direct smelting reduction process – Air flash smelting, oxygen flash, oxygenslip bath smelting, QSL process, refining of lead bullion. Pyro and electrolytic refining

UNIT-III

ALUMINUM: Raw materials, production of pure Al_2O_3, Bayer's process, Devillepechiney Process, Hall - Heroult cell, electrolyte, electrode reactions, Current efficiency, Cell Voltage, Anode effect: Refining of Aluminum, Alternative processes of aluminium production.

UNIT-IV

MAGNESIUM: Production of a hydrous Magnesium chloride from sea water and magnesite. Electro-winning practice and problem. Refining, Pidgeon and Hansgrig processes.

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

UNIT-V

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. Extraction of Zirconium

TEXT BOOKS:

1. Extraction of Non-Ferrous Metals - HS Ray, KP Abraham and R. Sridhar
2. Non Ferrous Extractive Metallurgy – G B Gill John Wiley & Sons 1980

REFERENCES:

1. Extractive Metallurgy of Copper - WGL Davln Port, U King, M Schelesinger and A.K. Biswas, Elsevier Science 2002
2. Metallurgy of Non-Ferrous Metals - WH Dennis.
3. Nuclear Chemical Engineering - Manstion Bendict and Thomas H. Pigfort

SURFACE ENGINEERING
(Professional Elective - I)

B.Tech. III Year II Sem.	L	T	P	C
Course Code: MM612PE	3	0	0	3

Course Objective: This course is mainly designed to make the students understand the importance of surface engineering techniques, scope, limitations and areas of applications. This course also focuses on industrially significant coating techniques, selection and evaluation of coating characteristics.

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

1. Understand the significance of surface modification processes
2. Describe the principles of surface modification processes
3. Identify the testing approaches to evaluate a modified surface
4. Suggest a surface modification process for a particular wear situation

UNIT-I

Importance and necessity of surface engineering; past, present and future scenario of surface engineering; classification of surface engineering processes; substrates and their pretreatments; coating characteristics: coating thickness, continuity, hardness, adhesion, porosity, and bond strength

UNIT-II

Thermally Sprayed Coatings: Plasma spraying; flame spraying, detonation spray coating, High velocity oxy-fuel spraying; cod gas dynamic spray process; thermal barrier coatings. Factors influencing thermal spray coatings. Electrochemical coatings.

UNIT-III

Diffusion Coatings: Process fundamentals, advantages, limitations and applications of carburizing, liquid nitriding, carbonitriding, nitrocarburizing, and boronizing. Aluminized, chromized, and siliconized coatings.

UNIT-IV

Thin Film Coating Technology: Chemical Vapor deposition (CVD); Physical Vapor Deposition (PVD); Electron beam evaporation; magnetron sputtering; diamond like carbon coating technology; sol-gel coating technologies

Plasma Processes: Plasma carburizing and plasma nitriding; plasma immersed ion implantation; plasma enhanced physical vapor deposition; plasma enhanced chemical vapor deposition.

UNIT-V

Thermal Modification Processes: different types of lasers and their applications. Laser assisted surface modification processes.

Evaluation of Coatings: Thickness, bond strength and porosity measurement; hardness, wear resistance and corrosion resistance.

TEXT BOOKS:

1. K G Budinski, Surface Engineering for wear resistance, Prentice Hall, New Jersey, 1998
2. Surface Engineering, Process fundamentals and applications, Vol I and II, Lecture Notes of SERC school of Surface Engineering
3. Howard E. Boyer (Editor), Case Hardening of Steel, ASM International, metals Park, OH 44073

REFERENCES:

1. Materials science- Van Vlack
2. Electroplating: Basic Principles and Practice - Kanan. N (Elsevier) 2004

ELECTRONIC AND MAGNETIC MATERIALS
(Professional Elective - I)

	L	T	P	C
B.Tech. III Year II Sem.				
Course Code: MM613PE	**3**	**0**	**0**	**3**

Course Objective

With the ever growing material world, the subject of metallurgy and materials engineering has grown in alarming complex manner. At the present the study of materials science has been greatly developed in many modern fields due to the new material such as magnetic, microelectronic and smart alloys. This subject is formulated to expose the students to the fundamentals and processing of magnetic and electronic materials

Course Outcome

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

1. Understand the properties to be considered in designing magnetic and electronic materials know the manufacturing process of electronic materials
2. Understand the concepts in development of smart materials and devices

UNIT-I

Magnetic Materials: Definition of Magnetic field, Magnetic Induction, Magnetic Field Intensity, Magnetic Susceptibility.

Types of Magnetic Materials: Paramagnetic, Diamagnetic, Ferromagnetic, Anti Ferromagnetic, Ferrimagnetic materials.

UNIT-II

Theories of Para, Dia and Ferromagnetism, Curie Temperature, Domain theory of Ferromagnetism, Reversible and Irreversible domains. Bark Haussan Effect.

UNIT-III

Hysteresis loop, Domain Interpretation of Hysteresis curve, interpretation of hysteresis and hand magnetic Materials, differences in magnetic properties of hard and soft magnetic materials, magnetic anisotropy and magnetostriction.

Applications of magnetic materials: soft and hard, high energy hard magnetic materials, magnetic storage, ferrite core memories, bubble memories

UNIT-IV

Semi conductors, Band theory and solids, distribution of energy states, classification of semi conductors, intrinsic and extrinsic , n type and p type, variation of carrier concentration with temperature, Hall effect, forward baising and reverse baising semi conductor devices

UNIT-V

Production of metallurgical grade silicon, photo lithography pattern transfer, metallization, silicon IC chip, packaging, encapsulation of IC chip, tape automated bonding, smart,

intelligent, active materials, piezo electric ceramics, polymers, chemical sensors, electrochemical sensors, shape memory alloys

TEXT BOOKS:

1. Electronic properties of materials, R E Hummel
2. Ferromagnetic materials structure and properties, RA Macurie

REFERENCES:

1. An introduction to materials science , HL Mancini
2. Magnetic Materials fundamentals and devices, Nicols Spaldin

WELDING METALLURGY LAB

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: MM604PC	**0**	**0**	**3**	**2**

Course Objective:

This Laboratory course is designed to make the student to understand and demonstrate the various types Welding processes and its variables, testing methods and correlation between micro structure and Mechanical properties of the Welded joints.

Course Outcomes:

The student would 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.

LIST OF EXPERIMENTS

1. Study of gas welding equipment and process. Identification of flames, making Butt joint with gas welding.
2. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
3. Study of resistance spot welding process and plot the variation of spot area with time and current variation
4. Study of Tungsten Inert Gas (TIG) welding process and measurement of temperature during TIG welding process.
5. Study of fundamental aspects of Submerged Arc Welding (SAW) process and finding out deposition efficiency of the process.
6. Study of fundamental aspects of MIG welding process
7. To conduct tests on weld joints to evaluate the mechanical properties of the joints, like bend test and ram tensile test.
8. To evaluate the microstructure of welded joint and understand the structural difference in
   Weld zone, Heat Affected Zone and Base metal.

FOUNDRY TECHNOLOGY LAB

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: MM605PC	**0**	**0**	**3**	**2**

Course Objective: This lab course is mainly designed to provide hands on practice on the various foundry testing methods for evaluation of moulding sand properties

Course Outcome: 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

LIST OF EXPERIMENTS

1. Preparation of gating system using green moulding sand.
2. Study of particle size distribution of the sand.
3. Study of the variation of permeability of the green sand with clay and water.
4. Determination of the variation of sand properties like green hardness, green compact strength with additives in sands.
5. Determination of the variation of hot compact hardness and hot shear strength with additives in sands.
6. Determination of clay content in sand.
7. Determination of the shatter index of green sand.
8. Melting of Al alloys in a pit furnace and casting into light components.
9. Study of Charge calculations and melting practice of cast iron in cupola.
10. Preparation of a shell-by-shell moulding process.
11. Study of Non-destructive testing of few components.

EQUIPMENT

1. Mould Boxes, Patterns, Core Boxes, Tool Boxes.	2. Rotap Sieve Shaker with Sieves
3. Permeability Apparatus.	4. Universal Sand Testing Machine with Accessories.
5. Sand Hardness tester.	6. Clay Content Apparatus
7. Shatter Index test.	8. For Melting; Pit Furnace; Electric Furnace
9. Shell Moulding Machine	10. Centrifugal Casting Machine
11. Ultra Sonic Tester	12. Ladles, Crucibles and other Accessories
13. Muffle Furnace 1000^0C	

ADVANCED ENGLISH COMMUNICATION SKILLS (AECS) LAB

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: EN606HS	**0**	**0**	**3**	**2**

Introduction

A course on *Advanced English Communication Skills (AECS) Lab* is considered essential at the third year level of B.Tech and B.Pharmacy courses. At this stage, the students need to prepare themselves for their career which requires them to listen to, read, speak and write in English both for their professional and interpersonal communication. The main purpose of this course is to prepare the students of Engineering for their placements.

Course Objectives

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve students' fluency in spoken English
- To enable them to listen to English spoken at normal conversational speed
- To help students develop their vocabulary
- To read and comprehend texts in different contexts
- To communicate their ideas relevantly and coherently in writing
- To make students industry-ready
- To help students acquire behavioural skills for their personal and professional life
- To respond appropriately in different socio-cultural and professional contexts

Course Outcomes

Students will be able to:

- Acquire vocabulary and use it contextually
- Listen and speak effectively
- Develop proficiency in academic reading and writing
- Increase possibilities of job prospects
- Communicate confidently in formal and informal contexts

Syllabus

The following course activities will be conducted as part of the Advanced English Communication Skills (AECS) Lab:

1. **Inter-personal Communication and Building Vocabulary** - Starting a Conversation – Responding Appropriately and Relevantly – Using Appropriate Body Language – Role Play in Different Situations - Synonyms and Antonyms, One-word Substitutes, Prefixes and Suffixes, Idioms and Phrases and Collocations.

2. **Reading Comprehension** –General Vs Local Comprehension, Reading for Facts, Guessing Meanings from Context, , Skimming, Scanning, Inferring Meaning.

3. **Writing Skills** – Structure and Presentation of Different Types of Writing – Letter Writing/Resume Writing/ e-correspondence/ Technical Report Writing.
4. **Presentation Skills** – Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs and Written Presentations through Posters/Projects/Reports/ e-mails/Assignments… etc.,

5. **Group Discussion and Interview Skills** – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas and Rubrics of Evaluation- Concept and Process, Pre-interview Planning, Opening Strategies, Answering Strategies, Interview through Tele-conference & Video-conference and Mock Interviews.

Minimum Hardware Requirement

Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics
- Eight round tables with five movable chairs for each table.
- Audio-visual aids
- LCD Projector
- Public Address system
- Computer with suitable configuration

Suggested Software:

The software consisting of the prescribed topics elaborated above should be procured and used.

- Oxford Advanced Learner's Compass, 8th Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.

REFERENCES:

1. Kumar, Sanjay and Pushp Lata. *English for Effective Communication*, Oxford University Press, 2015.
2. Konar, Nira. *English Language Laboratories – A Comprehensive Manual,* PHI Learning Pvt. Ltd., 2011.