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

Applicable From 2018-19 Admitted Batch

I YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA101BS	Mathematics - I	3	1	0	4
2	PH102BS	Engineering Physics	3	1	0	4
3	CS103ES	Programming for Problem Solving	3	1	0	4
4	ME104ES	Engineering Graphics	1	0	4	3
5	PH105BS	Engineering Physics Lab	0	0	3	1.5
6	CS106ES	Programming for Problem Solving Lab	0	0	3	1.5
7	*MC109ES	Environmental Science	3	0	0	0
		Induction Programme				
		Total Credits	**13**	**3**	**10**	**18**

I YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA201BS	Mathematics - II	3	1	0	4
2	CH202BS	Chemistry	3	1	0	4
3	ME203ES	Engineering Mechanics	3	1	0	4
4	ME205ES	Engineering Workshop	1	0	3	2.5
5	EN205HS	English	2	0	0	2
6	CH206BS	Engineering Chemistry Lab	0	0	3	1.5
7	EN207HS	English Language and Communication Skills Lab	0	0	2	1
		Total Credits	**12**	**3**	**8**	**19.0**

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**

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MM501PC	Non-Ferrous Extractive Metallurgy	3	1	0	4
2	MM502PC	Environmental Degradation of Materials	3	1	0	4
3	MM503PC	Mechanical Working of Metals	3	1	0	4
4	SM505MS	Engineering Economics and Accountancy	3	0	0	3
5		Professional Elective - I	3	0	0	3
6	MM504PC	Mechanical Working of metals Lab	0	0	3	1.5
7	MM505PC	Extractive Metallurgy Lab	0	0	3	1.5
8	MM506PC	Environmental Degradation of Materials Lab	0	0	2	1
9	*MC510	Intellectual Property Rights	3	0	0	0
		Total Credits	**18**	**3**	**8**	**22**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	MM601PC	Materials Characterization	3	1	0	4
2	MM602PC	Non-Metallic Materials	3	1	0	4
3	MM603PC	Material Processing (Casting & Welding)	3	1	0	4
4		Professional Elective - II	3	0	0	3
5		Open Elective –I	3	0	0	3
6	MM604PC	Material Processing Lab (Casting & Welding experiments)	0	0	3	1.5
7	MM605PC	Modeling and Simulations Lab for Metallurgical and Materials Engineering	0	0	3	1.5
8	EN608HS	Advanced Communication Skills Lab	0	0	2	1
9	*MC609	Environmental Science	3	0	0	0
		Total Credits	**18**	**3**	**8**	**22**

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MM701PC	Introduction to Instrumentation	3	0	0	3
2		Professional Elective - III	3	0	0	3
3		Professional Elective - IV	3	0	0	3
4		Open Elective - II	3	0	0	3
5	SM701MS	Fundamentals of Management for Engineers	3	0	0	3
6	MM702PC	Seminar	0	0	2	1

7	MM703PC	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
8	MM704PC	Project Stage - I	0	0	6	3
		Total Credits	**15**	**0**	**8**	**21**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective - III	3	0	0	3
2		Professional Elective - V	3	0	0	3
3		Professional Elective - VI	3	0	0	3
4	MM801PC	Project Stage - II	0	0	14	7
		Total Credits	**9**	**0**	**14**	**16**

***MC - Environmental Science – Should be Registered by Lateral Entry Students Only.**
***MC – Satisfactory/Unsatisfactory**

Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

Professional Elective – I

MM511PE	Powder Metallurgy
MM512PE	Nuclear Materials
MM513PE	Fatigue and Fracture Mechanics

Professional Elective – II

MM611PE	Nano Materials
MM612PE	Electronic Materials
MM613PE	Furnace Technology and Pyrometry

Professional Elective – III

MM711PE	Alternate Routes of Iron & Steel Making
MM712PE	Bio Materials
MM713PE	Non-Destructive Testing

Professional Elective – IV

MM721PE	Functional Materials
MM722PE	Computational Materials Engineering
MM723PE	Ceramics Science and Technology

Professional Elective – V

MM811PE	Advanced Manufacturing Technologies
MM812PE	Design and Selection of Engineering Materials
MM813PE	Composite Materials

Professional Elective – VI

MM821PE	Failure Analysis
MM822PE	Energy Materials
MM823PE	Super Alloys

MM701PC: INTRODUCTION TO INSTRUMENTATION

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

AIM: To study the basic instrumentation methods

Course Objectives: To have a knowledge of:

- Electronic Instruments
- Pressure measurements
- Flow measurements
- Vibration, Viscosity and Humidity Level measurement
- Various analysers

Course Outcomes:

- 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**.**

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 – Ionization 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

Analysers: Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyser – Sodium analyser – Silica analyser – Turbidity meter – Gas analyser – NOx analyser – H2S analyser – CO and CO2 monitor, Dust & Smoke measurement.

TEXT BOOKS:

1. Alan S. Morrris. Principles of Measurement and Instrumentation, Print ice-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.
4. Liptak B.G. Instrumentation Engineers Hand Book (Measurement), Chilton Book Co., 1994

MM711PE: ALTERNATE ROUTES OF IRON & STEEL MAKING (PE – III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- To learn alternate routes of iron making based on coal based and gas-based processes.
- Gain knowledge about important smelt reduction processes.
- To enhance the technical knowledge in secondary steel making processes.

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

- Comprehensive understanding of alternate routes to iron making concomitant to kinetics of reduction of oxides of iron.
- Knowledge about smelt reduction processes.
- Knowledge about the importance of secondary steel making processes and types of processes.

UNIT- I

Basics of iron and steel productions. The need for alternative routes, fundamentals of direct reduction, applications of DRI.

UNIT- II

Coal based DR processes; Rotary Kiln, Fast met, ITMK 3 process. Gas based DR processes: HYL process, Finmet, 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

Secondary Steel Making process, introduction, objectives, types, advantages and limitations.
Stirring techniques, synthesis, slag refining, injection metallurgy.

UNIT-V

Vacuum treatment of steel, RH process and DH process, post solidification treatments, ESR and VAR process.

TEXT BOOKS:

1. Sponge Iron Production by direct Reduction of Iron oxide, by Amit Chatterjee. PHI learning Pvt Ltd. M.D. 2nd Edition.
2. Hot Metal production by smelting reduction of Iron oxide, by Amit Chatterjee. PHI learning Pvt Ltd.
3. Ahindra Ghosh: Secondary steel Making – Principles and Applications, CRC press, 2001.

REFERENCE BOOKS:

1. Amit Chatterjee: Beyond the Blast Furnace, CRC press, 1992.
2. Steel Making – A.K. Chakrabarti. PHI.

MM712PE: BIO MATERIALS (PE – III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the student to the range of biomaterials and the science and engineering of biomaterials.
- To understand constraints associated with the use of biomaterials.

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

- Explain the types of Biomaterials and their relative advantages and disadvantages
- Indicate the constraints placed on the use of materials in biological environments
- Explain the characterization of materials from the perspective of application as a biomaterial

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.

MM713PE: NON-DESTRUCTIVE TESTING (PE – III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: The objective of the course is to introduce various non-destructive evaluation techniques applied to impact and test quality of manufacture products obtained by various manufacturing techniques such as welding, rolling, forging, casting, powder metallurgy etc. This subject also provides certification aspects of commercial products.

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

- Decide, select, use and interpret proper nondestructive methods for inspection and evaluation of engineering materials
- Evaluate the materials and structures for the causes of discontinuities, which interfere with the usefulness of the part
- Design nondestructive methods for inspection and evaluation of materials
- Design nondestructive methods for systems for quality assurance including production processes and assemblies

UNIT - I

Introduction, visual methods**:** Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection. Other methods, Acoustic Emission methods, Acoustic methods, Leak detection, Thermal inspection.

UNIT - II

Penetrant flaw detection**:** Principles, Process, 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

Radiographic methods: Limitations, Principles of radiography, sources of radiation, Ionising radiation - X-rays sources, Gama-rays sources Recording of radiation, Radiographic sensitivity, Fluoroscopic methods, special techniques, Radiation safety.

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.

UNIT - V

Electromagnetic testing: Magnetism, Magnetic domains, Magnetization curves, Magnetic Hysteresis, Hysteresis-loop tests, comparator - bridge tests Absolute single-coil system, applications. Electrical methods, Eddy current methods, potential-drop methods, applications, Thermal Imaging

TEXT BOOKS:

1. Non-Destructive Testing by P. Halmshaw
2. Practical Non Destructive testing, Baldev Raj, T. Jayakumar, M. Thavasimuthu, Woodhead Publishing, 2002

REFERENCE BOOK:

1. ASM Metals Handbook, Nondestructive inspection and quality control.

MM721PE: FUNCTIONAL MATERIALS (PE – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:
To introduce the student to functional materials and the science behind the performance of the functional material. To enable the student to understand the applications of functional materials

Course outcomes: After completing the course the student will be able to:
- Indicate the various type of functional materials
- Explain the principle of operation of the functional material
- Indicate the applications of the functional 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

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.

MM722PE: COMPUTATIONAL MATERIALS ENGINEERING (PE – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course objectives: This course introduces computational methods in the domain of metallurgical and materials engineering.

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

- Analyse a metallurgical problem to create a well posed numerical problem
- Identify initial and boundary conditions of a problem relevant to materials domain
- Propose a solution procedure for a numerical problem in the domain of materials engineering
- Demonstrate ability to quantify a materials engineering problem through numerical analysis

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/CO2 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 Nonlinear 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. Modeling in materials processing – J.A. Dantzig and C.L. Tucker III, Cambridge University Press (2001)
2. H. K. Versteeg, W. Malalsekera, “An Introduction to Computational Fluid Dynamics”, Longman Scientific and Technical, 1st Edition 1995.
3. S.C. Chapra, R.P. Canale, “Numerical Methods for Engineers”, McGraw Hill India Pvt. Ltd.,5th Edition, 2002
4. Santosh K. Gupta: Numerical Methods for Engineers, New Age International (P) Limited, New Delhi, 1998

RELATED LINKS:

- http://www.gnu.org/software/octave/
- http://gcc.gnu.org/codingconventions.html

MM723PE: CERAMICS SCIENCE AND TECHNOLOGY (PE – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objective: This course is intended to provide in depth knowledge on processing ceramic materials including structure, properties, phase transformations, applications, and fabrication methods of ceramics.

Course outcomes: Through this course, the student will be able

- To compare ceramics and understand their superiority over metals and other materials in some specific and critical applications.
- The student would also be benefited by understanding the various applications of ceramic materials in real time engineering.
- The student will be understanding various manufacturing techniques of ceramic materials.

UNIT - I

Introduction and Crystal structures: Definition, Classification of Ceramics, Traditional Ceramics, Structural Ceramics, Ceramic super conductors. Crystal structures in Ceramics, Grouping of ions and Pouling's rules, Oxide structures, Silicate structures, Glass formation, Models of glass structure Types of glasses.

UNIT - II

Equilibrium Diagrams of ceramic systems: Two component systems like $Al_2O_3 – SiO_2$ and $BaO – TiO_2$; and Three component systems $MgO – Al_2O_3 – SiO_2$

UNIT - III

Synthesis of Ceramic powders, microstructure, mechanical, Thermal, electrical, optical, magnetic, and chemical properties of ceramic materials

UNIT - IV

Powder Preparation Techniques: Sol-gel technology – Precipitation, Coprecipitation and Hydrothermal precipitation techniques. Preparation of Al_2O_3, ZrO_2, SiC, Si_3N_4 BN & B_4C.

UNIT - V

Ceramic Processing Techniques: Hot Pressing, Hot Isostatic Pressing, (HIP). Spark Plasma Sintering. Sintering, Sinter / HIP, Injection moulding, Slip casting, Tape casting, Gel casting, Extrusion.

TEXT BOOKS:

1. Introduction to Ceramics, W.D. Kingery et al, John Wiley
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCE BOOKS:

1. FINCER proceedings of workshop on fine ceramics synthesis, properties and applications, T.R. Rammohan et al.
2. Hand Book of Fibre, reinforced composite materials, Ed. Lubin.
3. Fundamentals of Ceramics, M W Barsoum
4. Ceramics, Mechanical Properties, Failure Behaviour, Material Selection, D. Munz & T. Fett
5. Ceramic Science and Technology, Vol. 2 Material Selection and Properties Ed., Ralf Riedel and I, Wei Chen, Wiely, VCH

SM701MS: FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objective:

- To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills for Engineers.

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; Production Planning and Control. 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: Job Satisfaction, Job Enrichment, Job Enlargement, Talent Management, 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 Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
2. Fundamentals of Management, Stephen P.Robbins, Pearson Education, 2009.

REFERENCE BOOKS:

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
3. Industrial Engineering and Management: Including Production Management, T.R. Banga, S.C. Sharma, Khanna Publishers.

MM811PE: ADVANCED MANUFACTURING TECHNOLOGIES (PE – V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: This course aims at making student to understand and design a material for a given application considering the composition, manufacturing process and properties that are required in service.

Course Outcomes:

- To understand the various manufacturing technologies for different materials.
- To correlate between manufacturing technology and the properties of Materials.
- To understand the Relationship between materials selection, processing and applications.

UNIT - I

Identification of processing parameters: Dynamic materials modeling and definition, safe processing zones, identification of safe window of processing

UNIT - II

Bulk deformation process: Isothermal forging, disc, ring rolling, incremental forging

UNIT - III

Powder process: Spray forming, Hot Isostatic Pressing (HIP), hot pressing and extrusion

UNIT - IV

Advanced Casting process: Full mold casting, Investment casting, Continuous casting and Vacuum casting

UNIT - V

Other Techniques: Rapid prototyping, severe plastic deformation techniques

TEXT BOOKS:

1. Advanced Techniques to Evaluate hot workability of materials - KP Rao, YVRK Prasad, Volume 3 - Comprehensive Materials Processing, Elsevier
2. Handbook of Workability and Process Design- G.E. Dieter, SL Semiatin

REFERENCE BOOKS:

1. Rapid protoyping of materials - Marquis FDS
2. Rapid prototyping and manufacturing Fundamentals and Stereo Lithography- PF Jacobs
3. Rapid prototyping: Laser based and Other technologies- PK Venu vinod
4. Hot Working Guide - A compendium of processing Maps -Authors - YVRK Prasad, Sasidhara
5. ASM Handbook Volume -7 Powder Metal Technology & Applications

MM812PE: DESIGN AND SELECTION OF ENGINEERING MATERIALS (PE – V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: This course aims at making student to understand and design a material for a given application considering the composition, manufacturing process and properties that are required in service

Course outcomes: Upon successful completion of the course, student will be

- To understand the criteria for selection of materials
- To understand the effect of composition, processing route and structure on materials properties.
- To understand the relationship between requirements of the materials for selection, processing and its applications

UNIT - I

Materials selection process: Criteria for selection of materials

UNIT - II

Effect of composition, processing and structure on materials properties Concepts in the design of industrial components

UNIT - III

Properties vs Performance materials: Aerospace and defence applications: design and alloy based on LCF, TMF, Creep fatigue interaction, hot corrosion resistance, role of DBTT for Naval applications, intermetallics, Aluminides

UNIT - IV

Manufacturing aspects of design, Nuclear application: radiation damage, effect of radiation damage on Yield stregth, Tensile Strength, Impact Strength, DBT Temperatures, design of an alloy for fission and fusion reactors.

UNIT - V

Materials aspects of design: Selection and design of polymers, ceramics and composites for specific applications,

TEXT BOOKS:

1. Material Selection and Design, Vol 20, ASM Hand Book, ASM International
2. M.F. Ashby, Materials Selection in Mechanical Design, Pergamon Press, 1992
3. G.E. Dieter, Engineering Design, A Materials and Processing Approach, 2nd ed., McGraw-Hill, 1991

REFERENCE BOOKS:

1. V. John, Introduction to Engineering Materials, 3rd ed., Industrial Press, 1992
2. T.H. Courtney, Mechanical Behavior of Materials, McGraw-Hill, 1990
3. J.R. Dixon and C. Poli, Engineering Design and Design for Manufacturing, Field Stone Publishers, 1995
4. Surface Engineering, Vol 5, ASM Handbook, ASM International, 1994
5. H.O. Fuchs and R.I. Stephens, Metal Fatigue in Engineering, John Wiley & Sons, 1980
6. S.T. Rolfe and J.M. Barsom, Fracture and Fatigue Control in Structures, 4th ed., Prentice-Hall, Inc., 1996

MM813PE: COMPOSITE MATERIALS (PE – V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- Develop understanding of the structure of ceramic materials on multiple length scales.
- Develop knowledge of point defect generation in ceramic materials, and their impact on transport properties.
- To describe key processing techniques for producing metal, ceramic-, and polymer-matrix composites.
- To demonstrate the relationship among synthesis, processing, and properties in composite materials.

Course Outcomes:

- Knowledge of the crystal structures of a wide range of ceramic materials and glasses.
- Able to explain how common fibers are produced and how the properties of the fibers are related to the internal structure.
- Able to select matrices for composite materials in different applications.
- Able to describe key processing methods for fabricating composites.

UNIT - I

Introduction: Definition, Classification of Composite materials based on structure, based on matrix, Advantages of composites, Applications of composites, Functional requirements of reinforcement and matrix.

UNIT - II

Types of reinforcements and their properties: Fibers: Carbon, Boron, Glass, Aramid, Al_2O_3, SiC, 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.

TEXTS 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

MM821PE: FAILURE ANALYSIS (PE – VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- Gain an understanding of fundamentals of fracture mechanics, Griffith crack theory.
- Analyze the crack behavior in various conditions.
- Obtain a working knowledge of failure analysis.

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

- Apply the knowledge of fracture mechanics under various conditions.
- Awareness about crack formation and crack growth in materials under various conditions.
- Able to analyze and take remedial steps in case of failure by fracture.

UNIT - I

Introduction to fracture mechanics: Fracture criteria, theoretical strength, stress-concentration factor, Griffith crack theory, strain-energy release rate.

UNIT - II

Mechanism of fracture: introduction, cleavage fracture, ductile fracture, fatigue cracking, environment assisted cracking, evaluation of fracture toughness. Introduction to LEFM: Concept, analysis of simple crack problems, nucleation and propagation of cracks, correlation between microstructure and fracture behaviour in different materials.

UNIT - III

Crack behaviour in elastic-plastic materials, effect of strain rate, environment, temperature, and irradiation on fracture behaviour of materials. Application of fracture mechanics to material selections, alloy design, and design of structures.

UNIT - IV

Conventional approach to fatigue crack growth in reactive environment, static and cyclic loading.

UNIT - V

Failure analysis: failure analysis methodology, failure types and characteristics, and concept of failure mechanism. Tools and techniques of failure analysis, case studies: in-process failure and service failure conditions.

TEXT BOOKS:

1. Fracture Mechanics: Fundamentals and Applications, T. L. Anderson, CRC Press, Inc., 1995.
2. Fracture and Fatigue Control in Structures, S.T. Rolfe and J.M. Barsom, Prentice-Hall, 1972.
3. Case Histories in Failure analysis, ASM, Ohio, 1979.

REFERENCE BOOKS:

1. ASM Handbook: Fatigue and Fracture, S. R. Lampman, (Rechnical Ed.) ASM International, 1996.
2. Elementary Engineering Fracture Mechanics, David Broek, Scjtoff & Noordhoff, 1978.
3. Failure analysis- R W Hertzberg, Deformation of Fracture Mechanics of Engineering Materials-John Wiley& Sons publications (1995).

MM822PE: ENERGY MATERIALS (PE – VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course objectives:

- To learn the operating principle of several environmentally friendly energy technologies.
- To identify the material issues relevant to these technologies and to evaluate various operational aspects associated with these technologies.

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

- Evaluate an energy technology for environmental friendliness
- Explain the operating principle of several energy technologies
- Indicate the material requirements for these energy technologies
- Demonstrate the ability to understand the characterization, performance, and failure data related to 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 BOOK:

1. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, 2004

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.

MM823PE: SUPER ALLOYS (PE – VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: The prime objective of the course is to make the students understand various superalloys applied in nuclear, aerospace and space Industries.

Course outcomes: Acquiring knowledge on the course,

- The student will be able to select demonstrate the physical metallurgy and properties of super alloys
- To understand the manufacturing and behaviour of the alloys at elevated temperatures.
- Gain the required knowledge for selecting the superalloys for specific applications

UNIT - I

Introduction to superalloys, Guide to selection of superalloys, wrought superalloys, Heat Resistant alloys. Physical Metallurgy; Microstructure of wrought Heat-Resisting Alloys, Microstructure of Ni-base & Co-base heat-resistant casting alloys. temperature and time-dependent transformation. Application to heat treatment of high temperature alloys.

UNIT - II

Relationship of properties to Microstructure in superalloys. Fracture properties of superalloys. High temperature corrosion and use of castings for protection. Effect of Physical Metallurgy and process variables on the microstructure of wrought superalloys. Process and Metallurgical factors affecting on superalloys and other high temperature materials.

UNIT - III

Melting Process**;** Melting of Superalloys; Principles and practices of vacuum Induction Melting and Vacuum Arc melting

UNIT - IV

Forming Methods**;** Forming and Fabrication of superalloys; Recent developments in P/M of superalloys-Production of components by Hot-Isostatic Pressing

UNIT - V

Casting methods - Improving turbine blade performance by solidification control -the development of single crystal turbine blades. Quality of super alloy castings; Heat Treating of Heat resistant alloys

TEXT BOOKS:

1. Superalloys; Source book; Mathew J. Donachie. Jr. editor; 1984.
2. The superalloys; edited by Chester T. Sims and William C Haagel; 1972

REFERENCE BOOKS:

1. Campbell IE High temperature MATERIALS, John Wiley and sons Inc.; 1956
2. The superalloys: fundamentals and applications By Roger C. Reed
3. Superalloys: a technical guide - Elihu F. Bradley-1988-280 pages
4. Superalloys A Technical Guide, Methew J. Donachie, Stephen J. Donachie