UNIVERSITY COLLEGE OF ENGINERRING VIZIANAGARAM

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF METALLURGICAL ENGINEERING

COURSE STRUCTURE & SYLLABUS

For UG – R20

B. TECH – METALLURGICAL ENGINEERING

(Applicable for batches admitted from 2020-2021)

UNIVERSITYCOLLEGEOFENGINEERINGVIZIANAGARAM
JAWAHARLALNEHRU TECHNOLOGICALUNIVERSITY KAKINADA
VIZIANAGARAM-535003, ANDHRAPRADESH,I NDIA

DEPARTMENT OF METALLURGACAL ENGINEERING

B.Tech COURSE STRUCTURE (2020Admittedbatch)

I B.Tech I Semester

S. No	Course Code	Course Title	L	T	P	C
1	R2011BS01	Calculus and Differential Equations	3	0	0	3
2	R2011BS05	Engineering Chemistry	3	0	0	3
3	R2011ES13	Problem solving & Programming using C	3	0	0	3
4	R2011ES06	Engineering Drawing	1	0	4	3
5	R2011ES01	Basic Electrical and Electronics Engineering	3	0	0	3
6	R2011ES01A	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5
7	R2011BS05A	Engineering Chemistry lab	0	0	3	1.5
8	R2011ES13A	Problem solving & Programming using C Lab	0	0	3	1.5

Total = 19.5

Category	Credits
Basic Science Course	7.5
Engineering Science Courses	7.5+4.5=12
Humanities & Social Science	00
Total Credits	19.5

I B.Tech II Semester

S. No	Course Code	Course Title	L	T	P	C
1	R2012BS02	Linear Algebra and Numerical Methods	3	0	0	3
2	R2012BS03	Engineering Physics	3	0	0	3
3	R2012HS01	Communicative English	3	0	0	3
4	R2012ES09	Engineering Mechanics	3	0	0	3
5	R2012ES08	Computer Aided Engineering Drawing	1	0	4	3
6	R2012BS03A	Engineering Physics Lab	0	0	3	1.5
7	R2012HS01A	English Communication Skills Lab	0	0	3	1.5
8	R2012ES11A	Engineering Workshop Practice	0	0	3	1.5
9	R2012MC01	Environmental Science	2	0	0	0

Total= 19.5

Category	Credits
Basic Science Course	7.5
Engineering Science Courses	7.5
Humanities & Social Science	4.5
	19.5

II B.Tech I Semester

S. No	Course Code	Course Title	L	T	P	C
1	R2021BS01	Vector calculus, Transformations and Partial Differential Equations	3	3	0	3
2	R202131PC01	Mineral Processing and Metallurgical Analysis	3	3	0	3
3	R202131PC02	Physical Metallurgy	3	3	0	3
4	R202131PC03	Thermodynamics and Kinetics	3	3	0	3
5	R202131PC04	Foundry Technology	3	3	0	3
6	R202131PC01A	Foundry Technology Lab	0	0	3	1.5
7	R202131PC02A	Mineral Processing and Metallurgical Analysis Lab	0	0	3	1.5
8	R202131PC03A	Physical Metallurgy Lab	0	0	3	1.5
9	R202131SC01	Metallurgical Microscopy and image analysis	1	2	0	2
10	R2021MC01	Constitution of India	2	0	0	0

Total=21.5

Category	Credits
Basic Science Course	3
Professional Core courses	16.5
Skill oriented course	02
Total Credits	21.5

II B.Tech II Semester

S. No	Course Code	Course Title	L	T	P	C
1	R202231PC01	Industrial Heat Treatment	3	3	0	3
2	R202231ES01	Elements of Mechanical Engineering	3	3	0	3
3	R202231PC02	Corrosion Engineering	3	3	0	3
4	R202231PC03	Principles of Extractive Metallurgy	3	3	0	3
5	R2022HS01	Managerial Economics and Financial Analysis	3	3	0	3
6	R202231ES01A	Mechanics of Solids Lab	0	0	3	1.5
7	R202231PC01A	Heat Treatment Lab	0	0	3	1.5
8	R202231PC02A	Corrosion Lab	0	0	3	1.5
9	R202231SC01	Advanced communication skills	1	2	0	2
					Total	21.5
Internship 2 Months (Mandatory) during summer vacation						
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)			4	0	0	4

Category	Credits
Basic Science Course	3
Engineering Science Courses	4.5
Humanities& Social Science	3
Professional Core Course	9
Skill oriented course	2
Total Credits	21.5

III B.Tech I Semester

S.No	Course Code	Course Title	L	T	P	C
1	R203131PC01	Mechanical Behavior of Materials	3	3	0	3
2	R203131PC02	Iron making and Steel making	3	3	0	3
3	R203131PC03	Welding Technology	3	3	0	3
4	R203131OE01	Open Elective-I: 1.Introduction to Materials science 2.Basics of Crystallography 3.Metallurgical Process Modelling	3	3	0	3
5	R203131PE01	Professional Elective-I: 1. Fuels, Furnaces and Refractories 2. Light Metal Technology 3. Functional Materials	3	3	0	3
6	R203131PC01A	Welding Technology Lab	0	0	3	1.5
7	R203131PC02A	Materials Testing Lab	0	0	3	1.5
8	R203131SC01	Basics of Non-Destructive Testing	1	0	2	2
9	R2031MC01	Essence of Indian Traditional Knowledge	2	0	0	0
	Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester		0	0	0	1.5
Total						21.5
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)			4	0	0	4

Category	Credits
Professional Core Course	12
Professional Elective courses	3
Open Elective Course/Job oriented elective	3
Skill oriented course	2
Summer Internship	1.5
Total Credits	21.5

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III B.Tech II Semester

S.No	Course Code	Course Title	L	T	P	C
1	R203231PC01	Materials Characterization	3	3	0	3
2	R203231PC02	Powder Metallurgy	3	3	0	3
3	R203231PC03	Metal Forming	3	3	0	3
4	R203231OE01	Open Elective-II: 1. Fatigue and Fracture Mechanics 2. High Temperature Materials 3. Materials Testing	3	3	0	3
5	R203231PE01	Professional Elective-II: 1. Non-Destructive Testing and evaluation 2. Biomaterials 3. Polymer Science and Technology	3	3	0	3
6	R203231PC01A	Materials Characterization Lab	0	0	3	1.5
7	R203231PC02A	Metal Forming Lab	0	0	3	1.5
8	R203231PC03A	Powder Metallurgy Lab	0	0	3	1.5
9	R203231SC01	Artificial Intelligence	1	0	2	2
10	R2032MC01	Professional Ethics and Human Values	2	0	0	0
					Total	21.5
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)			4	0	0	4
Industrial/Research Internship (Mandatory) 2 Months during summer vacation						

Category	Credits
Professional Core Course	13.5
Professional Elective courses	3
Open Elective Course/Job oriented elective	3
Skill oriented course	2
Mandatory course	0
Industrial/Research Internship	0
Total Credits	21.5

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IV B.Tech I Semester

S. No	Course Code	Course Title	L	T	P	C
1	R204131PE01	Professional Elective-III: 1. Magnetic and Electronic Materials 2. Nuclear Materials 3. Non Ferrous Extractive Metallurgy	3	3	0	3
2	R204131PE02	Professional Elective-IV: 1. Chemical analysis of metals 2. Energy Materials 3. Ceramic Science and Technology	3	3	0	3
3	R204131PE03	Professional Elective-V: 1. Surface Engineering and Tribology 2. Nanomaterials 3. Special Purpose Steels	3	3	0	3
4	R204131OE01	Open Elective-III: 1. Transport Phenomena 2. Composites 3. Computational Materials Science	3	3	0	3
5	R204131OE02	Open Elective-IV: 1. Solidification Processing 2. Metallurgical Failure Analysis 3. Ferro Alloy Technology	3	3	0	3
6	R2041HS01	*Humanities and Social Science Elective 1.Industrial Management 2.Human Resources Development 3. Strategic Management 4. Innovation and Entrepreneurship	3	3	0	3
7	R204131SC01	Finite Element Analysis Tools	1	0	2	2
	Industrial/Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester		0	0	0	3
Total						23
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)			4	0	0	4

***There is a provision for the Universities/Institutions to implement AICTE mandatory course "Universal Human Values 2: Understanding Harmony" under Humanities and social science Elective in seventh semester for 3 credits.**

Category	Credits
Professional Elective courses	9
Open Elective Course/Job oriented elective	6
Skill oriented course	2
Humanities and Social Science Elective	3
Industrial/Research Internship	3
Total Credits	23

IV B.Tech II Semester

S.No	Category	Code	Course	Hours per week			C
1	Major Project	R204231PR01	Project Project work, seminar and internship in industry	0	0	0	12
	INTERNSHIP (6 MONTHS)						
						Total	12

COURSES OFFERED FOR HONORS DEGREE

S.NO.	COURSE NAME	L	T	P	CR	OFFERED TO
POOL1						
1	Advanced Manufacturing Technology	3	1	0	4	MET
2	Nano composites and applications	3	1	0	4	MET
3	Plasticity & Plastic Deformation	3	1	0	4	MET
4	Advanced Thermodynamics of Materials	3	1	0	4	MET
POOL2						
1	Advanced Powder Metallurgy	3	1	0	4	MET
2	Thin Film Science and Technology	3	1	0	4	MET
3	Statistical Quality Control	3	1	0	4	MET
4	FEM Techniques in Materials Processing	3	1	0	4	MET
POOL3						
1	Carbon Nano Technology	3	1	0	4	MET
2	Materials and Energy balance in Metallurgical Processes	3	1	0	4	MET
3	Advanced ceramics for strategic applications	3	1	0	4	MET
4	Nano Material Synthesis	3	1	0	4	MET
POOL4						
1	Additive Manufactureing	3	1	0	4	MET
2	Advances in iron and steel making	3	1	0	4	MET
3	Super Alloys	3	1	0	4	MET
4	Aerospace Materials	3	1	0	4	MET

COURSES OFFERED FOR MINORS DEGREE

S.NO.	COURSE NAME	L	T	P	CR	OFFERED TO
Track 1						
1	Physical Metallurgy	3	1	0	4	MET
2	Thermodynamics and Kinetics	3	1	0	4	MET
3	Heat Treatment	3	1	0	4	MET
4	Engineering Materials	3	1	0	4	MET
Track 2						
1	Welding Technology	3	1	0	4	MET
2	Foundry Technology	3	1	0	4	MET
3	Corrosion Engineering	3	1	0	4	MET
4	Composite Materials	3	1	0	4	MET
Track 3						
1	Materials Characterization	3	1	0	4	MET
2	Material Testing	3	1	0	4	MET
3	Introduction to Materials Engineering	3	1	0	4	MET
4	Non Metallic Materials	3	1	0	4	MET
Track 4						
1	Nano Materials	3	1	0	4	MET
2	Powder Metallurgy	3	1	0	4	MET
3	Smart materials	3	1	0	4	MET
4	Design and Selection of Materials	3	1	0	4	MET

B.Tech - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
NAME OF THE SUBJECT: CALCULUS AND DIFFERENTIAL EQUATIONS					

(Common to all branches)

Course Objectives:

(i) This course will illuminate the students in the concepts of calculus.
(ii) To enlighten the learners in the concept of differential equations and multivariable calculus.(iii)To equip the students with standard concepts and tools at an intermediate to advanced levelmathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

UNIT I:

Sequences, Series and Mean value theorems: (10 hrs)

Sequences and Series: Convergence and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series – Leibnitz's rule.

Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders.

UNIT II:

Differential equations: (15 hrs)

Linear differential equations – Bernoulli's equations – Exact equations and equations reducible to exact form

Non-homogeneous equations of higher order with constant coefficients with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, e^{ax} V(x) and x^nV(x) – Method of Variationof parameters- Euler-Cauchy equation and Legender's equation

Applications: Orthogonal trajectories – Electrical circuits (RL, RC, RLC) – Simple Harmonic motion.

UNIT III:

Partial differentiation: (10 hrs)

Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mac Laurin's series expansion of functions of two variables.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT IV:

Multiple integrals: (8 hrs)

Double integrals – Change of order of integration - Double integrals in polar coordinates- Areas enclosed by plane curves- Triple integrals – Volume of solids – Change of variables to polar, spherical and cylindrical co-ordinates.

Applications: Finding Areas and Volumes.

UNIT V:

Beta and Gamma functions: **(5 hrs)**

Introduction to Improper Integrals-Beta and Gamma functions- Properties - Relation between Betaand Gamma functions- Evaluation of improper integrals.

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

(i) Utilize mean value theorems to real life problems (L3)
(ii) Solve the differential equations related to various engineering fields (L3).
(iii) Familiarize with functions of several variables which are useful in optimization (L3)
(iv) Apply double and triple integration techniques in evaluating areas and volumes bounded byregion (L3)
(v) Conclude the use of Beta and Gamma functions in evaluating improper integrals (L4)

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw HillEducation.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Joel Hass, Christopher Heil and Maurice D. Weir,** Thomas calculus, 14th Edition, Pearson.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press, 2013.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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B.Tech-I Semester		L	T	P	C
		3	0	0	3
NAME OF THE SUBJECT : ENGINEERING CHEMISTRY					

(Common to Mechanical, MET, Civil)

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

Course Objectives:

(i) ***Importance*** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
(ii) ***Outline*** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
(iii) ***Express*** the increases in demand as wide variety of advanced materials are introduced; which have excellent engineering properties. Classify and discuss the materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries. Lubrication is also summarized.
(iv) ***Relate*** the need of fuels as a source of energy to any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence introduced.
(v) ***Explain*** the importance and usage of water as basic material in almost all the industries; ***interpret*** drawbacks of steam boilers and also how portable water is supplied for drinking purposes.

UNIT I:

POLYMER TECHNOLOGY **8 hrs**

Polymerisation:- Introduction, methods of polymerization (emulsion and suspension), mechanical properties.

Plastics: Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste (waste to wealth).

Elastomers:- Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).

Composite materials: Fiber reinforced plastics, conducting polymers, biodegradable polymers, biopolymers, biomedical polymers.

UNIT II:

ELECTROCHEMICAL CELLS AND CORROSION **10 hrs**

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery and zinc air cells), fuel cells (H_2-O_2, CH_3OH-O_2, phosphoric acid and molten carbonate).

Corrosion:-Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, factors influencing rate of corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electro less plating [nickel]), Paints

UNIT III:

CHEMISTRY OF MATERIALS **10 hrs**

Part- A:

Nano materials:- Introduction, sol-gel method, characterization by (Brunauer Emmet Teller [BET]), (scanning electron microscopy [SEM]) and (transmission electron microscopy [TEM]) with example (TiO_2), applications of graphene and fullerenes, carbon nanotubes (types, preparation and applications)

Thermal analysis techniques: Instrumentation and applications of thermo gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC).

Part-B:

Refractories: - Definition, classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

Lubricants: - Definition, mechanism of lubricants, properties (definition and importance).

Cement: - Constituents, manufacturing, parameters to characterize the clinker formation: lime saturation factor (LSF), silica ratio (SR) and alumina ratio (AR), chemistry of setting and hardening, deterioration of cement.

UNIT IV:

FUELS **10 hrs**

Introduction, calorific value, higher calorific value, lower calorific values, problems using Dulong's formula, proximate and ultimate analysis of coal sample and their significance, numerical problems, petroleum (refining-cracking), synthetic petrol (Fischer Tropsch and Bergius), petrol knocking, diesel knocking, octane and cetane ratings, anti-knocking agents, Introduction to alternative fuels (Bio-diesel, ethanol, methanol, natural gas, liquefied petroleum gas, compressed natural gas), Flue gas analysis by Orsat apparatus, rocket fuels.

UNIT V:

WATER TECHNOLOGY **8 hrs**

Hardness of water, determination of hardness by complexometric method, boiler troubles (priming and foaming, scale formation, boiler corrosion, caustic embrittlement), internal treatments, softening of hard water (zeolite process and related sums, ion exchange process), treatment of industrial waste water, potable water and its specifications, steps involved in purification of water, chlorination, break point chlorination-desalination (reverse osmosis and electro dialysis).

Course Outcomes: ***At the end of this unit, the students will be able to***

(i) ***Analyze*** the different types of composite plastic materials and interpret the mechanism of conduction in conducting polymers.

(ii) ***Utilize*** the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion

(iii) ***Synthesize*** nanomaterials for modern advances of engineering technology. Summarize the techniques that detect and measure changes of state of reaction. Illustrate the commonly used industrial materials.

(iv) ***Differentiate*** petroleum, petrol, synthetic petrol and have knowledge how they are produced. Study alternate fuels and analyse flue gases.

(v) ***Analyze*** the suitable methods for purification and treatment of hard water and

brackish water.

Books:

1. P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latestedition).
2. Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
4. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).

Reference Books:

1. K. Sesha Maheshwaramma and Mridula Chugh, "**Engineering Chemistry**", Pearson IndiaEdn.
2. O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
3. CNR Rao and JM Honig (Eds) "Preparation and characterization of materials" Academic press,New York (latest edition)
4. B. S. Murthy, P. Shankar and others, "Textbook of Nanoscience and Nanotechnology", University press (latest edition)

B.Tech- I Semester		L	T	P	C
		3	0	0	3
NAME OF THE SUBJECT : PROBLEM SOLVING AND PROGRAMMING USING C					

(Common to all branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

- To impart adequate knowledge on the need of programming languages and problem-solving techniques and develop programming skills.
- To enable effective usage of Control Structures and Implement differentoperations on arrays.
- To demonstrate the use of Strings and Functions.
- To impart the knowledge of pointers and understand the principles of dynamic memory allocation.
- To understand structures and unions and illustrate the file concepts and its operations.
- To impart the Knowledge Searching and Sorting Techniques.

UNIT-I

Introduction to Computer Problem Solving: Programs and Algorithms, Computer Problem Solving Requirements, Phases of Problem Solving, Problem. Solving Strategies,Top-Down Approach, Algorithm Designing, Program Verification, Improving Efficiency, Algorithm Analysis and Notations.

UNIT-II

Introduction to C Programming: Introduction, Structure of a C Program. Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements. Operators, Type Conversion.

Control Flow, Relational Expressions: Conditional Branching Statements: if, if-else, if-else—if, switch. Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, go to statement.

UNIT-III

Arrays: Introduction, Operations on Arrays, Arrays as Function Arguments, Two dimensional Arrays, Multi dimensional arrays.

Pointers: Concept of a Pointer, Declaring and Initializing Pointer Variables, Pointer Expressions and Address Arithmetic, Null Pointers, Generic Pointers, Pointers as Function Arguments, Pointers and Arrays, Pointer to Pointer, Dynamic Memory Allocation, Dangling Pointer, Command Line Arguments,

UNIT-IV

Functions: Introduction, Function Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes. Recursion.

Strings: String Fundamentals, String Processing with and without Library Functions, Pointers and Strings.

UNIT-V

Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type — Enum variables, Using Typedef keyword, Bit Fields.

Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Course Outcomes:

At the end of the Course, Student should be able to:

i. Illustrate the Fundamental concepts of Computers and basics of computer programming.
ii. Use Control Structures and Arrays in solving complex problems.
iii. Develop modular program aspects and Strings fundamentals.
iv. Demonstrate the ideas of pointers usage.
v.Solve real world problems using the concept of Structures, Unions and File operations.

Text Books:

i. How to solve it by Computer, R. G. Dromey, and Pearson Education.
ii. Computer Programming. Reema Thareja, Oxford University Press
iii. Let us C , Yaswanth Kanetkar, 16th Edition,BPB Publication.

Reference Books:

i. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
ii. Programming In C A-Practia1 Approach. Ajay Mittal, Pearson.
iii. C Programming — A Problem Solving Approach, Forouzan, Gilberg, Cengage.
iv. The C Programming Language, Dennis Richie And Brian Kernighan, PearsonEducation.
v. Programming In C, Ashok Kamthane, Second Edition, Pearson Publication.

Web Links:

- http://www.c4learn.com/
- http://www.geeksforgeeks.org/c/
- http://nptel.ac.in/courses/122104019/
- http://www.learn-c.org/
- https://www.tutorialsyoint.com/cprogramming/

B.Tech-I Semester		L	T	P	C
		1	0	4	3
NAME OF THE SUBJECT : ENGINEERING DRAWING					

Course Objectives:

The objectives of this course is to acquire knowledge on the:

i. To introduce the students to use of drawing instruments and draw engineering curves.

ii. To introduce the students to use orthographic projections, projections of points & simple lines. To make the students to draw the projections of the lines inclined to both theplanes.

iii. The objective is to make the students draw the projections of the plane objects in different positions with the reference planes.

iv. The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.

v. The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view.

UNIT - I:

Curves: Parabola, Ellipse and Hyperbola by general and special methods, cycloids, tangents & normals for the curves

Scales: Plain scales, diagonal scales and vernier scales

UNIT - II:

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

UNIT - III:

Polygons: Constructing regular polygons by general methods.

Projections of planes: Regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT - IV:

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one plane – auxiliary views.

UNIT-V

Conversion of isometric views to orthographic views and Conversion of orthographic views to isometric views.

Course Outcomes:

The students should be able to:

i. To make the student familiar with the techniques used for drawing various geometric elements used in engineering practice

ii. The student can apply the orthographic projections, project the points and lines parallelto

one plane and inclined to both the planes.
iii. Prepare the drawings for construction of regular polygons and the projection of the planes inclined to both the planes.
iv. The students can prepare the drawings for the projections of the various types ofsolids in different positions inclined to one plane of the planes
v. Ability to use the concepts of isometric views to orthographic views and vice-versa.

Text Books:

i. Engineering Drawing by N.D. Bhatt, Chariot Publications
ii. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

Reference Books:

i. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
ii. Engineering Graphics for Degree by K.C. John, PHI Publishers
iii. Engineering Graphics by PI Varghese, McGrawHill Publishers
iv. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja

B.Tech-I Semester		L	T	P	C
		3	0	0	3
NAME OF THE SUBJECT : BASIC ELECTRICAL AND ELECTRONICS ENGINEERING					

(Common to CIVIL, MECH, MET Engg.)

Course objectives:

The objectives of this course is to acquire knowledge on the

i. principle of operation and construction details of DC machines & Transformers.
ii. principle of operation and construction details of alternator and 3-Phase induction motor.
iii. PN junction diode, half wave, full wave rectifiers and zener diode.
iv. PNP and NPN transistors and various amplifiers.

Unit - I

Electrical Circuits

Basic definitions – types of network elements – Ohm's Law – Kirchhoff's Laws – inductive networks – capacitive networks – series – parallel circuits –Numerical Problems.

Unit - II

DC Machines

Principle of operation of DC generator- types of DC machines - EMF equation- OCC & Load characteristics- principle of operation of DC Motor—torque equation – applications – three point starter – speed control methods of DC motor – Swinburne's Test and Brake Test.

Unit - III

AC Machines
&Transformers
Transformers:

Principle of operation and construction of single phase transformers – EMF equation –OC & SCtests – losses & efficiency.

AC Machines

Principle of operation of 3-Phase induction motor– slip-torque characteristics – Brake Test - efficiency – applications - principle of operation and construction of alternators – types of alternators - principle of operation of synchronous motor.

Unit IV

Diodes and Rectifiers

Classification of Semiconductors–intrinsic-extrinsic-PN junction diode-Forward bias & Reverse Bias- V-I Characteristics- diode as rectifier-half wave and bridge rectifier (with and without filter)-Zener diode-characteristics, applications.

Unit V
Transistor
s

Transistors, transistor as an amplifier–CE & CB connections-characteristics, Basic principles of Feedback Amplifiers-Types, Basic principle and characteristics of operational amplifiers (OP-AMP) – application of OP-AMPs (inverting, non-inverting, integrator and differentiator).

Course Outcomes:

The student should be able to:

i. understand the basics of series and parallel electrical circuits.
ii. Understand the operation and performance of DC machines and testing of DC shunt motorby Swinburne's test and brake test.
iii. principle of operation, construction and performance of AC machines (transformers, synchronous machines and 3-phase &1-phase induction motors)
iv. understand the concept of semiconductor diodes, operation of half wave, full wave bridgerectifiers, characteristics and applications of Zener diode.
v. analyze the concept of transistors and amplifiers.

Text Books:

i. Electrical Technology by Surinder Pal Bali, Pearson Publications.
ii. Electronic Devices and Circuits by R.L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.

Reference Books:

i. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group
ii. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
iii. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition.
iv. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition.
v. Industrial Electronics by G.K. Mittal, PHI.

B.Tech- I semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
	NAME OF THE SUBJECT: BASIC ELECTRICAL AND ELECTRONICS ENGINEERINGLAB				

(Common to CIVIL, MECH, MET Engg.)

Course objectives:

The objectives of this course is to acquire knowledge on the

i. efficiency of dc shunt machine, transformer and 3-phase induction motor by conductingdirect/indirect tests.
ii. speed control methods of DC shunt motor
iii. characteristics of various basic semiconductor devices.

Any Five Experiments are to be conducted from each section.

Section A: Electrical Engineering:

1. Verification of Kirchhoff's Laws (Kirchhoff's Current Law and Kirchhoff's Voltage Law).
2. Swinburne's test on D.C. Shunt machine (predetermination of efficiency of a given D.C. shuntmachine working as motor and generator).
3. Speed control of D.C. Shunt motor by
   a) Armature Voltage control b) Field flux control method
4. Brake test on D.C. Shunt Motor.
5. Magnetization characteristics on DC Shunt generator
6. Load characteristics on DC Shunt generator
7. OC and SC tests on single phase transformer (predetermination of efficiency at given powerfactors).
8. Brake test on 3-phase Induction motor (determination of performance characteristics)

Section B: Electronics Engineering:

1. Static characteristics of PN junction diode
2. V-I characteristics of Zener-diode
3. Half and full wave rectifier with and without filters.
4. Transistor CB characteristics (input and output)
5. Transistor CE characteristics (input and output)
6. Study of amplifiers.
7. OP- Amp applications (inverting, non-inverting, integrator and differentiator)

Course Outcomes:

The student should be able to:

i. compute the efficiency of DC shunt machine with/without loading the machine.
ii. Estimate the efficiency at different load conditions and power factors for single phasetransformer with OC and SC tests.
iii. analyze the performance characteristics of 3-Phase induction motor.
iv. control the speed of dc shunt motor using armature voltage and field flux control methods.
v. analyze the characteristics of PN junction diode, transistor and determine the ripple factorof half wave and full wave rectifiers.

Text books:

i. Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand publications
ii. Theory & performance of Electrical Machines by J.B.Guptha, S.K.Kataria & Sons
iii. Electrical Machinery by P.S. Bhimbra, Khanna Publishers.

Reference books:

i. Basic Electrical Engineering by M.S.Naidu & S.Kamakshiah, TMH Publications.
ii. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2ndedition.
iii. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition.

*****

		L	T	P	C
B.Tech-I Semester		**0**	**0**	**3**	**1.5**
NAME OF THE SUBJECT: ENGINEERING CHEMISTRY LAB					

(Common to Mechanical, MET, Civil)

Course Objectives:

The objectives of this course is to acquire knowledge on the

(i) Normality, molarity, theory of indicators used in different volumetric and chemical analysis.
(ii) Alkalinity and hardness of water by E DTA method.
(iii) Volumetric analysis Red- Ox titrations of different chemical compounds.
(iv) Determination of concentration of acids and bases using conductometer andpotentiometer
(v) Determination of P^H and colour metric analysis

Introduction to Chemistry laboratory – Molarity, normality, primary, secondarystandard solutions, Volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
3. Determination of Mn^{+2} using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of Cu^{+2} using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Fe^{+3} by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of iso-electric point of amino acids using pH-metrymethod/conductometric method.
10. Determination of the concentration of strong acid vs strong base(by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Determination of Mg^{+2} present in an antacid.
13. Determination of $CaCO_3$ present in an egg shell.
14. Estimation of Vitamin C.
15. Determination of phosphoric content in soft drinks.
16. Adsorption of acetic acid by charcoal.
17. Preparation of nylon-6, 6 and Bakelite (demonstration only).
18. Determination of Lead in drinking water.

19. Determination of percentage of copper in Brass.

Of the above experiments at-least 10 assessment experiments should be completedin a semester.

Course Outcomes:

(i) Student is exposed to volumetric titrations acquires some volumetric skills.
(ii) Student is able to analyze hard and soft water.
(iii) Student is exposed to volumetric skills of red-ox titrations with differentindicators
(iv) Students can handle the instruments like conductometer, potentiometer indetermining the concentrations of acids and bases.
(v) Student is able to analyze the different chemical concentrations using colorimeter and P^H meter.

Reference Books

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.
2. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co. Latestedition

B.TECH-I Semester		L	T	P	C
		0	0	3	1.5
NAME OF THE SUBJECT: PROBLEM SOLVING AND PROGRAMMING USING C LAB					

(Common to all branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

- To impart knowledge on basic Linux commands, various Editors, Raptor.
- To make the students understand the concepts of C programming.
- To nurture the students on Control Structures and develop different operations on arrays.
- To make use of String fundamentals and modular programming constructs.
- To implement programs using dynamic memory allocation.
- To explain the concepts of Structure, Unions and files for solving various problems.

List of Experiments:

1. **Introduction to Algorithms and Flowcharts**

Implement Algorithm Development for Exchange the values of Two numbers.

Given a set of n student's examination marks (in the range 0-100) make a count of the number of students that passed the examination. A Pass is awarded for all of 50 and above.

Given a set of n numbers design an algorithm that adds these numbers and returns the resultant sum. Assume N is greater than or equal to zero.

2. Introduction to C Programming

Basic Linux Commands.

Exposure to Turbo C, Vi, Emacs, Code Blocks IDE, Dev C++.

Writing simple programs using printf (), scanf () .

3. Raptor

Installation and Introduction to Raptor.

Draw a flow chart to find the Sum of 2 numbers.

Draw a flow chart to find Simple interest.

4. Basic Math

Write a C Program to convert Celsius to Fahrenheit and vice versa.

Write a C Program to find largest of three numbers using ternary operator.

Write a C Program to Calculate area of a Triangle using Heron's formula.

5. Control Flow- I

Write a C Program to Find Whether the Given Year is a Leap Year or not.

Write a C program to find the roots of a Quadratic Equation.

Write a C Program to make a simple Calculator to Add, Subtract, Multiply or Divide UsingSwitch...case.

6. Control Flow- II

Write a C Program to Find Whether the Given Number is Prime number or not.

Write a C Program to Find Whether the Given Number is Armstrong Numberor not.

Write a C program to print Floyd Triangle.

7. Control Flow- III

Write a C program to find the sum of individual digits of a positive integer.

Write a C program to check whether given number is palindrome or not.

Write a C program to read two numbers, x and n, and then compute the sum of the geometric progression $1+x+x'+x^3+\ldots\ldots\ldots\ldots+x^n$.

8. Arrays

Write a C program to search an element in the given array (Linear Search).

Write a C program to perform matrix addition.

Write a C program to perform matrix multiplication.

9. Pointers

Write a C Program to Perform Addition. Subtraction, Multiplicationand Division of two numbers using Command line arguments.

Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.

Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function.

10. Functions, Array & Pointers

Write a C Program to demonstrate parameter passing in Functions.

Write a C Program to find Fibonacci. Factorial of a number withrecursion and without recursion.

Write a C Program to find the sum of given numbers with arrays and pointers.

11. Strings

Implementation of string manipulation operations with library function:

a.copy

b. concatenate

c.length

d. compare

I 1.2) Implementation of string manipulation operations without library function:

a. copy

b. concatenate

c.length

d. compare

12. Structures

Write a C Program to Store Information of a book Using Structure.
Write a C Program to Add Two Complex Numbers by Passing Structure to a Function.

13. Files

Write a C program to open a file and to print the contents of the file on screen.
Write a C program to copy content of one file to another file.
Write a C program to merge two files and store content in another file.

14. Application

Creating structures to capture the student's details save them in file in properrecord format. Search and prints the student details requested by the user.

Note: Draw the flowcharts using Raptor from Experiment 3 to Experiment 6.

Course Outcomes:

- Implement basic programs in C and design flowcharts in Raptor.
- Use Conditional and Iterative statements to solve real time scenarios in C.
- Implement the concept of Arrays and Modularity and Strings.
- Apply the Dynamic Memory Allocation functions using pointers.
- Develop programs using structures, and Files.

Text Books:

i. Let us C , Yaswanth Kanetkar, 16th Edition,BPB Publication.
ii. How to solve it by Computer, R. G. Dromey, and Pearson Education.
iii. Computer Programming. Reema Thareja, Oxford University Press

Reference Books:

i. Programming in C A-Practical Approach Ajay Mittal. Pearson Education.
ii. The C programming Language, Dennis Richie and Brian Kernighan,Pearson Education.
iii. Problem solving using C , K Venugopal,3'd Edition, TMG Publication.

Web Links:

1. https://www.hackerrank.com/
2. https://www.codechef.com/
3. https://www.topcoder.com/
4. https://code-cracker.github.io/
5. https://raptor.martincar1is1e.com/
6. httos://npte1.ac.in/courses/106105055/2

		L	T	P	C
B.Tech-II Semester		**3**	**0**	**0**	**3**
NAME OF THE SUBJECT: LINEAR ALGEBRA AND NUMERICAL METHODS					

(Common to all branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

(i) To instruct the concept of Matrices in solving linear algebraic equations
(ii) To elucidate the different numerical methods to solve nonlinear algebraic equations
(iii) To disseminate the use of different numerical techniques for carrying out numerical integration.
(iv) To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications

UNIT – I:

Systems of linear equations, Eigen values and Eigen vectors: (10 hrs)

Rank of a matrix by echelon form and normal form – Solving system of homogeneou sand non-homogeneous linear equations – Gauss Elimination method – Eigen values and Eigen vectors and their properties.

Applications: Free vibration of a two-mass system.

UNIT – II:

Cayley-Hamilton theorem and Quadratic forms: (10 hrs) Cayley-Hamilton theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton theorem –Reduction to Diagonal form– Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation.

Singular values of a matrix, singular value decomposition (Ref. Book – 1).

UNIT – III:

Iterative methods: (8 hrs)

Introduction– Solutions of algebraic and transcendental equations : Bisection method– Secant method – Method of false position– Iteration method – Newton-Raphson method (One variable and simultaneous Equations)

Solutions of system of equations - Jacobi and Gauss-Seidel methods
Evaluation of largest eigenvalue –eigenvector using Power Method.

UNIT – IV:

Interpolation: **(10 hrs)**

Introduction - Errors in polynomial interpolation – Finite differences– Forward differences– Backward differences –Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula– Newton's divide difference formula.

UNIT–V:

Numerical integration and solution of differential equations with initial conditions:
(10 hrs) Trapezoidal rule– Simpson's 1/3rd and 3/8th rule– Solution of differential equations with initial conditions by Taylor's series– Picard's method of successive approximations– Euler's method –Runge-Kutta method (second and fourth order) – Milne's Predictor and Corrector Method.

Course Outcomes: The student will be able to

(i) Develop the use of matrix algebra techniques that is needed by engineers forpractical applications (L6)
(ii) Solve system of linear algebraic equations using Gauss elimination, Gauss Jordan,Gauss Seidel (L3)
(iii) Evaluate approximating the roots of polynomial and transcendental equationsby different algorithms (L5)
(iv) Apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals (L3)
(v) Apply different algorithms for approximating the solutions of ordinary differentialequations to its analytical computations (L3)

Text Books:

(i) **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
(ii) **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw HillEducation.

Reference Books:

(i) **David Poole,** Linear Algebra- A modern introduction, 4th Edition, Cengage.
(ii) **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science, Tata Mc. Graw Hill Education.
(iii) **M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific andEngineering Computation, New Age International Publications.
(iv) **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

B.Tech- II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
NAME OF THE SUBJECT: ENGINEERING PHYSICS					

(Common to CE, ME & MET)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications

ii. Understand the mechanism for emission of light, utility of lasers as coherent light sources for low and high energy applications, study of propagation of light through optical fibers and their implications in optical communications.

iii. Open new avenues of utility for dielectric and magnetic materials as potential sources for micro devices.

iv. Familiarize the concepts of theoretical acoustics for their practical utility in engineering acoustics. Explanation for the significance of ultrasound and its application in NDT application.

v. Enlighten the periodic arrangement of atoms in Crystalline solids by Bragg's law – Learning the structural analysis through X-ray diffraction

UNIT I:

Wave Optics **12hrs**

Interference: Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications -Colours in thin films- Newton's Rings- Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits(Qualitative) – Grating - resolving power of Grating(Qualitative).

Polarization: Introduction-Types of polarization - Polarization by reflection and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT II:

Lasers and Fiber optics **10hrs**

Lasers: Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein's coefficients – Population inversion –Lasing action- Pumping mechanisms – Ruby laser – He-Ne laser - Applications of lasers.

Fiber optics: Introduction –Principle of optical fiber- Acceptance Angle-Numerical Aperture-Classification of optical fibers based on refractive index profile and modes – Block diagram of fiber optics communication.

UNIT III:

Dielectric and Magnetic Materials **8hrs**

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative), Ionic

(Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius-Mossotti equation.

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Origin of permanent magnetic moment - Classification of magnetic materials: Dia, para, Ferro, antiferro & Ferrimagnetic materials - Domain conceptfor Ferromagnetism (Qualitative) - Hysteresis - soft and hard magnetic materials.

Unit-IV:

Acoustics and Ultrasonics **10hrs**

Acoustics: Introduction – requirements of acoustically good hall– Reverberation – Reverberation time– Sabine's formula (Derivation using growth and decay method) - Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedial measures.

Ultrasonics: Introduction - Properties - Production by magnetostriction and piezoelectric methods – Detection - Acoustic grating - Non Destructive Testing-Transducers – pulse echo system through transmission and reflection modes - Applications.

Unit-V:

Crystallography and X-ray diffraction **8hrs**

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattice – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer– crystal structure determination by Laue's powder method-XRD pattern of amorphous, crystalline, and nanomaterials.

Course Outcomes:

The students should be able to

i. **understand** the concepts of physical optics through the wave nature of light and **discuss** the phenomenal differences between interference, diffraction and polarization.

ii. **describe** the basic laser physics, working of lasers, and principle of propagation of light in optical fibers.

iii. **explain** the basics of dielectric and magnetic materials to synthesize new materials asper needs of engineering applications.

iv. **apply** the knowledge of Ultrasonic to understand non destructive testing and **analyze** Acoustic properties of typically used materials in buildings

v. **recognize** various planes in a crystal and describe the structure determination using x-rays.

Text books:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand andCompany
2. Engineering physics – D.K. Battacharya and Poonam Tandon, Oxford Universitypress.
3. Engineering Physics by P.K.Palanisamy SciTech publications.

Reference Books:

1. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons
2. Engineering Physics – M.R.Srinivasan, New Age Publications
3. Engineering Physics – D K Pandey, S. Chaturvedi, Cengage Learning

B.Tech- II Semester		L	T	P	C
		3	0	0	3
NAME OF THE SUBJECT : COMMUNICATIVE ENGLISH					

(Common to all branches)

Course Objectives

(i) Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers

(ii) Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials

(iii) Help improve speaking skills through participation in activities such as role plays,discussions and structured talks/oral presentations

(iv) Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information

(v) Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Unit 1:

A Drawer full of happiness

Listening: Listening to short audio texts and identifying the topic. Listening to prose,prose and conversation.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self introductions and introducing others.

Reading: Skimming text to get the main idea. Scanning to look for specific pieces of information.

Reading for Writing: Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

Vocabulary: Technical vocabulary from across technical branches (20) GRE Vocabulary

(20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.

Grammar: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.

Pronunciation: Vowels, Consonants, Plural markers and their realizations

Unit 2:

Nehru's letter to his daughter Indira on her birthday

Listening: Answering a series of questions about main idea and supporting ideas afterlistening to audio texts, both in speaking and writing.

Speaking: Discussion in pairs/ small groups on specific topics followed by shortstructured talks. Functional English: Greetings and leave takings. **Reading**: Identifying

sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what isread; avoiding redundancies and repetitions.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications) **Grammar**: Use of articles and zero article; prepositions.

Pronunciation: Past tense markers, word stress-di-syllabic words

Unit 3:

Stephen Hawking-Positivity 'Benchmark'

Listening: Listening for global comprehension and summarizing what is listened to, bothin speaking and writing.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed. Functional English: Complaining and Apologizing.

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Criticalreading.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing.E-mail etiquette, Writing CV's.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words

Grammar: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

Pronunciation: word stress-poly-syllabic words.

Unit 4:

Liking a Tree, Unbowed: Wangari Maathai-biography

Listening: Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Functional English: Permissions, Requesting, Inviting.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

Reading for Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables . Writing SOP, writing for media.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters. **Grammar**: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

Pronunciation: Contrastive Stress

Unit 5:

Stay Hungry-Stay foolish

Listening: Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.

Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides. Functional English: Suggesting/Opinion giving.

Reading: Reading for comprehension. RAP Strategy Intensive reading and Extensive reading techniques.

Reading for Writing: Writing academic proposals- writing research articles: format and style.
Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.

Grammar: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Pronunciation: Stress in compound words

Course Outcomes:

At the end of the module, the learners will be able to

(i) Understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
(ii) Ask and answer general questions on familiar topics and introduce oneself/others
(iii) Employ suitable strategies for skimming and scanning to get the general idea of atext and locate specific information
(iv) Recognize paragraph structure and be able to matchbeginnings/endings/headings with paragraphs
(v) Form sentences using proper grammatical structures and correct word forms

Prescribed text books:

(i) "**Infotech English**", Maruthi Publications. (Detailed)

Reference Books

1. Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge,2014.
2. Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) MacmillanEducational.
4. Hewings, Martin. *Cambridge Academic English (B2).* CUP, 2012
5. Martin Hewings , Advanced English Grammar, Cambridge university press
6. William Strunk JR. and E B White, Elements of Style, 4th Edition, Pearson
7. *Language and Life: A Skills Approach* Board of Editors, Orient Black Swan Publishers,India. 2018.
8. *Practical English Usage,* Michael Swan. OUP. 1995.
9. *Remedial English Grammar,* F.T. Wood. Macmillan.2007
10. *On Writing Well,* William Zinsser. Harper Resource Book. 2001

11.*Study Writing*, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press.2006.
12.*Communication Skills*, Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.

13.*Exercises in Spoken English*, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.
14.*Advanced English Grammar*, Martin Hewings. Cambridge University Press. 2016
15.*Elements of Style*, William Strunk and EB White. Pearson. 1999.

B.Tech-II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
NAME OF THE SUBJECT : ENGINEERING MECHANICS					

(Common to ME, CE and MET)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. The students are to be exposed to the concepts of force and friction, direction and its application.
ii. The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.
iii. The students are to be exposed to concepts of centre of gravity. The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.
iv. The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.
v. The students are to be exposed to rigid motion kinematics and kinetics.

UNIT – I

Introduction to Engineering Mechanics – Basic Concepts.

Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.

Friction: Introduction**,** limiting friction and impending motion, coulomb's laws of dryfriction, coefficient of friction, cone of friction

UNIT II

Equilibrium of Systems of Forces: Free Body Diagrams, , Lami's Theorem, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

UNIT – III

Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity: Centre of gravity of simple body (from basic principles), centre ofgravity of composite bodies, Pappus theorems.

Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia:** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – IV

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics- D'Alembert's Principle, Work Energy method and applications to particle motion- Impulse momentum method.

UNIT – V

Rigid body Motion: Kinematics and kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse momentum method.

Course Outcomes:

The students should be able to:

i. To learn the principles (Axioms) of statics, able to find resultant & resolution of systemof forces and resultant force.

ii. Explore the concepts of constraints, free body diagram and action-reaction.

iii. Estimate the geometric parameters like centroid, centre of gravity and moment of inertia and identify their application.

iv. Learn the analysis of frames and trusses and know the importance of friction.

v. Able to determine solution to dynamic problems through D'Alembert equilibrium equations, Impulse-Momentum and work– energy method

Text Book:

1. Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw Hillpublications.
2. Engineering Mechanics statics and dynamics – R.C.Hibbeler, 11th Edn – PearsonPubl.
3. Theory & Problems of engineering mechanics, statics & dynamics – E.W.Nelson, C.L.Best & W.G. McLean, 5th Edn – Schaum's outline series - Mc Graw Hill Publ.

Reference Books:

1. Engineering Mechanics , statics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
2. Engineering Mechanics , dynamics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
3. Engineering Mechanics , statics and dynamics – I.H.Shames, – Pearson Publ.
4. Mechanics For Engineers , statics - F.P.Beer & E.R.Johnston – 5th Edn Mc GrawHill Publ.
5. Mechanics For Engineers, dynamics - F.P.Beer & E.R.Johnston –5th Edn Mc GrawHill Publ.
6. Engineering Mechanics , Fedinand . L. Singer , Harper – Collins.
7. Engineering Mechanics statics and dynamics , A Nelson , Mc Graw Hillpublications
8. Engineering Mechanics, Tayal. Umesh Publ.

		L	T	P	C
B.Tech-II Semester		**1**	**0**	**4**	**3**
NAME OF THE SUBJECT : COMPUTER AIDED ENGINEERING DRAWING					

(Common to CE and MET)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. The knowledge of projections of solids is essential in 3D modeling and animation. The student will be able to draw projections of solids. The objective is to enhance the skills they already acquired in their earlier course in drawing of projection.
ii. The knowledge of sections of solids and development of surfaces is required in designing and manufacturing of the objects. Whenever two or more solids combine, a definite curve is seen at their intersection
iii. The intersection of solids also plays an important role in designing and manufacturing. The objective is to impart this knowledge through this topic. A perspective view provides a realistic 3D View of an object. The objective is to make the students learn the methods of Iso and Perspective views.
iv. The objective is to introduce various commands in AutoCAD to draw the geometric entities and to create 2D and 3D wire frame models.
v. By going through this topic the student will be able to understand the paper-space environment thoroughly.
vi. The objective is to make the students create geometrical model of simple solids and machine parts and display the same as an Isometric, Orthographic or Perspective projection.

UNIT-I:

PROJECTIONS OF SOLIDS: Projections of Regular Solids inclined to both planes - Auxiliary Views.

UNIT-II:

SECTIONS OF SOLIDS: Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views.

DEVELOPMENT OF SOLIDS: Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid, Cone and their parts.

UNIT-III:

INTERPENETRATION OF RIGHT REGULAR SOLIDS: Intersection of Cylinder VsCylinder, Cylinder Vs Prism, Cylinder Vs Cone, Prism Vs Cone.
PERSPECTIVE PROJECTIONS: Perspective View: Points, Lines, Plane Figures and Simple Solids, Vanishing Point Methods (General Method only).

In part B computer aided drafting is introduced.

UNIT IV:

INTRODUCTION TO COMPUTER AIDED DRAFTING: Generation of points, lines, curves, polygons, dimensioning. Types of modeling: object selection commands – edit, zoom, cross hatching, pattern filling, utility commands, 2D wire frame modeling, 3D wire frame modeling,.

UNIT V:

VIEW POINTS AND VIEW PORTS: view point coordinates and view(s) displayed, examples to exercise different options like save, restore, delete, joint, single option.

UNIT VI:

COMPUTER AIDED SOLID MODELING: Isometric projections, orthographic projections of isometric projections, Modeling of simple solids, Modeling of Machines & Machine Parts.

Course Outcomes:

The students should be able to learn:

i. The concepts of projections of solids inclined to both the planes
ii. The concepts of sections of solids and developments of surfaces
iii. The interpenetration of right regular solids.
iv. Basics in AutoCAD.
v. Concepts of view points and view ports and draw 2D and 3D objects using edit commands in AutoCAD.
vi. Computer aided solid modeling techniques

Text Books:

1. Engineering drawing by N.D Bhatt , Charotar publications.
2. Engineering Graphics, K.C. john, PHI Publications

References Books:

1. Mastering Auto CAD 2013 and Auto CAD LT 2013 – George Omura, Sybex
2. Auto CAD 2013 fundamentals- Elisemoss, SDC Publ.
3. Engineering Drawing and Graphics using Auto Cad – T Jeyapoovan, vikas
4. Engineering Drawing + AutoCAD – K Venugopal, V. Prabhu Raja, New Age
5. Engineering Drawing – RK Dhawan, S Chand
6. Engineering Drawing – MB Shaw, BC Rana, Pearson
7. Engineering Drawing – KL Narayana, P Kannaiah, Scitech
8. Engineering Drawing – Agarwal and Agarwal, Mc Graw Hill
9. Engineering Graphics – PI Varghese, Mc Graw Hill
10. Text book of Engineering Drawing with auto-CAD , K.venkata reddy/B.S .publications.
11. Engineering Drawing with Auto CAD/ James D Bethune/Pearson Publications
12. Engineering Graphics with Auto CAD/Kulkarni D.M, Rastogi A.P, SarkarA.K/PHI Publications

End Semester examination shall be conducted for **Four** hours with the following pattern:

a) Two hours – Conventional drawing
b) Two hours – Computer Aided Drafting

B.Tech- II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Name of the Subject Engineering Physics Lab					

(Common to CE, ME & MET)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To **impart skills** in measurements with accurate error propagation.
ii. To **plan** the experimental procedure, **design** and to record and **analysis** results.
iii. To reach non trivial conclusions of significant of the experiments.
iv. To **develop** the skills to handle different instruments without taking erroneous readings and ability to enhance the skills to fabricate engineering and technical equipments.

List of experiments:

1. Laser: Determination of wavelength using diffraction grating.
2. Study of variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method.
3. Determination of ultrasonic velocity in given liquid (Acoustic grating).
4. Determination of dielectric constant for different materials.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of Planck's constant using reverse photoelectric effect.
7. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum).
8. Determination of numerical aperture and acceptance angle of an optical fiber.
9. Determination of thickness of thin object by wedge method.
10. Determination of radius of curvature of given plan convex lens by Newton's rings.
11. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
12. Determination of dispersive power of the prism.
13. Determining the velocity of ultrasonic waves by using an ultrasonic interferometer.
14. Measurement of magnetic susceptibility by Quick's method.
15. Measurement of magnetic susceptibility by Kundt's tube method.

Course outcomes: The students will be able to

i. **Describe** the methodology of science and the relationship between observation and theory.
ii. **Develop** scientific problem solving skills, including organization of given information, identification and application of pertinent principles, quantitative solutions, interpreting results, and evaluating the validity of results.
iii. **Discover** of physics concepts in other disciplines such as mathematics, computer science, engineering, and chemistry.
iv. **Learn** to minimize contributing variables and recognize the limitations of equipment.
v. **Apply** conceptual understanding of the physics to general real-world situations.
vi. **Develop** interpersonal and communication skills including communicating in small groups, writing, working effectively with peers.

Reference Books:

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.

B.Tech- II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Name of the Subject : English Communication Skills Lab					

(Common to all branches)

Course Objectives

(i) To impart grammar as well as communication through pronunciation. By introduction, pure vowels, consonants, diphthongs, phonetic transcription, common errors in pronunciation.

(ii) To impart better knowledge on Stress. Stress of kinds- mono syllabic, di syllabic,poly syllabic, strong and weak forms of stress along with contrastive stress.

(iii) To impart learner grammar as well as communication through compound words, rhythm, intonation and accent neutralization

(iv) To impart learner grammar as well as communication through listening, by identifying the context and specific pieces of information to answer a series of questions in speaking

(v) To improve the spoken skills of students by making them read news papers in order to understand and identify key terms context they read .

UNIT I:

Vowels, Consonants, Pronunciation, Phonetic Transcription, Common Errors in Pronunciation,

UNIT II:

Word stress-di-syllabic words, poly-syllabic words, weak and strong forms, contrastive stress (Homographs)

UNIT III:

Stress in compound words, rhythm, intonation, accent neutralisation.

UNIT IV:

Listening to short audio texts and identifying the context and specific pieces of information to answer a series of questions in speaking.

UNIT V:

Newspapers reading; Understanding and identifying key terms and structures usefulfor writing reports.

Course Outcomes:

At the end of the module, the learners will be able to

(i) The learner will improve phonetic understanding, transcription, common errors both in pronunciation and written English.

(ii) The learner will improve syllabic division, and how to use right stress in theirpronunciation.

(iii) The learner will improve speaking skills with right intonation and rhythm andintonation and how to reduce mother tongue influence in English.

(iv) The learner will Improve speaking skills as well as listening skills by listeningthrough the audio clips prescribed.

(v) The learner will Improve speaking skills along with reading skills.

Prescribed text book:

(i) "**InfoTech English**", Maruthi Publications.

References:

1. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.
5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
6. English Phonetics for Indian Students- P. Bala Subramanian, Mac MillanPublications.

		L	T	P	C
B.Tech- II Semester		**0**	**0**	**3**	**1.5**
NAME OF THE SUBJECT : ENGINEERING WORKSHOP PRACTICE					

(Common to ME, CE and MET)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To impart hands-on practice on Carpentry trade and skills.
ii. To impart hands-on practice on Fitting trade and skills
iii. To impart hands-on practice on Black Smithy trade and skills
iv. To impart hands-on practice on House Wiring trade and skills
v. To impart hands-on practice on Tin Smithy trade and skills

Note: At least two exercises to be done from each trade.

Trade:

1. **Carpentry** 1. T-Lap Joint
   2. Cross Lap Joint
   3. Dovetail Joint
   4. Mortise and Tenon Joint
2. **Fitting** 1. Vee Fit
   2. Square Fit
   3. Half Round Fit
   4. Dovetail Fit
3. **Black Smithy** 1. Round rod to Square
   2. S-Hook
   3. Round Rod to Flat Ring
   4. Round Rod to Square headed bolt
4. **House Wiring** 1. Parallel / Series Connection of three bulbs
   2. Stair Case wiring
   3. Florescent Lamp Fitting
   4. Measurement of Earth Resistance
5. **Tin Smithy** 1. Taper Tray
   2. Square Box without lid
   3. Open Scoop
   4. Funnel
6. **IT Workshop** 1.Assembly & Disassembly of Computer

Course Outcomes:

The students should be able to:

i. Understand and practice Carpentry tools and trade.
ii. Apply various types of Fitting tools and practice the trade
iii. Understand and practice Black Smithy tools and trade
iv. Apply concepts of House Wiring trade
v. Analyze working of various tools of Tin Smithy trade
vi. Understand the basic hardware of computer

		L	T	P	C
B.Tech- II Semester		**3**	**0**	**0**	**0**
NAME OF THE SUBJECT: ENVIRONMENTAL SCIENCE					

(Common to All branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

(i) The natural resources and their sustenance of the life and recognize the need to conserve the natural resources.
(ii) The concepts of ecosystem and its functions in the environment .The need forprotecting the producers and consumers and their role in the food web.
(iii) The biodiversity of India and the threats to biodiversity, and the conservationpractices to protect the biodiversity.
(iv) Various attributes of the pollution and their impacts and measures to reduce orcontrol the pollution along with waste management.
(v) Social issues both rural and urban environment and the possible means to combat the challenges

UNIT - I:

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, Scope and Importance - Need for public Awareness.

Natural Resources : Renewable and non-renewable resources - Natural resources and associated problems - Forest resources - Use and over - exploitation, deforestation, case studies - Timberextraction - Mining, dams and other effects on forest and tribal people - Water resources - Use andover utilization of surface and ground water - Floods, drought, conflicts over water, dams - benefitsand problems - Mineral resources: Use and exploitation, environmental effects of extracting and usingmineral resources, case studies

- Food resources: World food problems, changes caused by agricultureand overgrazing, effects of modem agriculture, fertilizer-pesticide problems, water logging, salinity,

case studies. - Energy resources:

UNIT - II:

ECOSYSTEMS, BIODIVERSITY AND ITS CONSERVATION

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem - Producers,consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains,food webs and ecological pyramids - Introduction, types, characteristic features, structure and functionof the ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems(ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its Conservation : Definition: genetic, species and ecosystem diversity - Biogeographicalclassification of India - Value of biodiversity: consumptive use, Productive use, social,ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as amega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching ofwildlife, man-wildlife conflicts -

Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III:

Environmental Pollution and solid waste Management

Environmental pollution: Definition, Cause, effects and control measures of : Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes -Role of an individual in prevention of pollution - Pollution case studies - Disaster management: floods, earthquake, cyclone and landslides.

UNIT - IV:

SOCIAL ISSUES AND THE ENVIRONMBNT

Social Issues and the Environment: From Unsustainable to Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, watershed management -Resettlement and rehabilitation of people; its problems and condemns. Case studies - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies - Wasteland reclamation' – Consumer is mand waste products. - Environment Protection Act. - Air (Prevention and Control of Pollution) Act. -Water (prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act -

Issues involved in enforcement of environmental legislation * Public awareness.

UNIT - V:

HUMAN POPULATION AND THE ENVIRONMENT

Human population and the Environment: Population growth, variation among nations' Population explosion - Family Welfare programmed. - Environment and human health - Human Rights – Value Education - HIV/AIDS - Women and Child Welfare - Role of information Technology in Environment and human health - Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain - Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds - river,hill slopes, etc"

Course Outcomes:

The students should be able to:

(i) Gain a higher level of personal involvement and interest in understanding and solving ' environmental problems

(ii) Comprehend environmental problems from multiple perspectives with emphasis on human modern lifestyles and developmental activities

(iii) Demonstrate knowledge relating to the biological systems involved in the majorglobal environmental problems of the 2lst century.

(iv).Influence their society in proper utilization of goods and services, Recognize theinterconnectedness of human dependence on the earth's ecosystems.

(v) Learn the management of environmental hazards and to mitigate disasters and have a clear

Text Books:

(i) Text book of Environmental Studies for Undergraduate Courses by Erach Bharuch for University Grants Commission, Universities Press.

(ii) Environmental Studies by Palani swamy - Pearson education

(iii) Environmental Studies by Dr.S.Azeem Unnisa, Academic Publishing Company

Reference Books:

(i) Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy,Cengage Publications.

(ii) Text book of Environmental Sciences and Technology by M.Anji Reddy, BSPublication.

(iii) Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.

(iv) Environmental sciences and engineering - J. Glynn Henry and Gary W. Heinke -Prentice hallIndia Private limited.

(v) A Text Book of Environmental Studies by G.R.Chatwal, Himalaya PublishingHouse

(vi) Introduction to Environmental engineering and science by Gilberl M. Mastersand Wendell P.Ela - Prentice hall of India Private limited

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B.Tech III-Semester	MINERAL PROCESSING AND METALLURGICAL ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:

1. *To study the scope of ore dressing and to describe the various crushers used in ore dressing.*
2. *To explain the theory and principles of various sizing techniques. It also describes the movement of solids in fluids by explaining the effect of various parameters on the movement of solids.*
3. *The basic concepts involved in jigging and tabling will be detailed to understand the working of various jigging machines and other equipment involved with tabling.*
4. *To know the importance of various methods of Metallurgical chemical analysis.*
5. *To describe various instrumental analysis.*

UNIT I

Scope and objective of ore dressing, Theory of liberation of minerals. Crushers: -Jaw, Gyratory, Cone, Rolls, and toothed roll crushers.

Types of grinding operations like batch and continuous 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.

Classification of classifiers, study of settling cones, rake classifier, spiral classifier, and cyclones. Heavy media separation: Principles, flow chart, different media used. Heavy media separation using heavy liquids and heavy suspensions.

UNIT III

Jigging: Theory of jigging. Jigging machines: hand jig, Harz jig, Denver jig, Baum jig, Hancock jig, James coal jig, and halkyn jig. Design considerations in a jig.

Flotation: Principles of flotation, Factors affecting flotation. Classification of collectors and frothers. Application of flotation process for Cu, Pb and Zn ores. Magnetic separation processes and electrostatic separation process.

UNIT IV

Scope of metallurgical analysis, classification of various methods used in metallurgical analysis.

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

UNIT-V:

Instrumental analysis: Importance of instrumental analysis –Comparison with standard wet chemical methods, absorptiometry ,colorimetry and spectrophotometry.

Course Outcomes:

Students will be able

1. *To understand the theory, principle and working of various ball mills used for size reduction.*
2. *To understand the principles and working of classifiers.*
3. *To understand the principles and applications of flotation and other separation processes*
4. *to compare the results with different wet methods*

5. *To estimate different components by instrumental analysis.*

CO PO Mapping

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*
CO1	√	√					√					
CO2	√	√		√					√			
CO3	√	√			√							
CO4	√	√	√				√					
CO5	√	√							√			

(*Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)*

TEXTBOOK:

1. Principles of Mineral Dressing by A.M. Gaudin.
2. S.K.Jain-Metallurgical analysis

REFERENCES:

1. Elements of Ore Dressing by A.F. Taggart
2. Mineral processing technology-.A. Wills
3. Ore dressing practices-S.K.Jain.
4. Vogel Al., A Text Book of Quantitative Inorganic Analysis Longman ELBS 1962.
5. Willard H.H.etal: Instrumental Methods of analysis Van Nostrand.

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B.Tech III-Semester	PHYSICAL METALLURGY	L	T	P	C
		3	0	0	3

Course Objective:

1. To understand the basic crystal structures of various materials which forms the basis for the subsequent study of properties of materials.
2. To understand the constitution and necessity of alloy formation.
3. The chapter outlines the various experimental methods of construction of phase diagrams.
4. The unit intended to describe various phase diagrams and phase transformations.
5. To provide the detailed explanation of phase transformations in steels.

UNIT – I

Structure of Metals, classification of metals, metallic bond-crystal structure of metals, coordination number, relationship between lattice parameter and atomic radius, packing factor and density calculations, interstitials, polymorphism, plane and directional indices, transformation of indices.

UNIT – II

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

UNIT – III

Equilibrium Diagrams: Experimental methods for construction of equilibrium diagrams, Isomorphous alloy systems, eutectic, partial eutectic systems and other systems.
Solidification: Types of Nucleation, determination of the size of critical nucleus, equilibrium cooling and heating of alloys, lever rule, coring, miscibility gaps. Simple problems using lever rule.

UNIT – IV

Transformation in solid-state, allotropy, order-disorder transformation, eutectoid, peritectoid reactions and complex phase diagrams, relation between equilibrium diagrams and physical properties of alloys. Study of important binary phase diagrams like Fe-Fe_3 C, Cu-Zn, Cu-Sn, and Al-Cu.

UNIT – V

Phase transformations in steels: pearlitic, martensitic and bainitic transformations, cooling curves, Isothermal transformation diagrams, transformations on continuous cooling, Concept of diffusion Fick's first law and second law.

Course Outcomes:

Students will be able

1. To understand the geometry and crystallography of crystalline materials; Identify planes and directions in crystal systems.
2. To apply the associated Hume Rothery rules for the formation of alloys.
3. To outline the solidification behaviour of materials during cooling.
4. To understand the concept of phase diagram in recognizing the phase changes
5. To understand the importance of isothermal diagrams.

CO PO Mapping

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4	√	√										
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities with special focus on academically weak students) should be tested periodically in classes by giving problems with respect to Phase diagrams and others. Unit tests are to be conducted at the end of each unit).

TEXTBOOK:

1. Introduction to Physical Metallurgy – S.H. Avner- McGraw-Hill publishers
2. Physical Metallurgy – Vijayendra Singh, Standard Publishers Distributors, 2005

REFERENCES:

1. Physical Metallurgy principles-Reed Hill – CENGAGE Learning Publishers
2. Engineering Physical Metallurgy and Heat Treatment – Y. Laktin.
3. Elements of Physical Metallurgy – A.Guy
4. Metallographic laboratory practice – Kehl
5. Principles of Physical Metallurgy – Smith. M.
6. Introduction to Metallurgy – A.H. Cottrell
7. Metallurgy for Engineers-Clark and Varney.
8. Physical Foundations of Materials Science – G. Gottstein
9. The Science and Engineering of Materials – Askeland et. al.
10. Physical Metallurgy – William F Hasford – CRC Press
11. Callister's Materials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley, 2015

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B.Tech III-Semester	Vector Calculus, Transforms and PDE	L	T	P	C
		3	0	0	3

Course Objectives:

(i) To familiarize the techniques in partial differential equations

(ii) To furnish the learners with basic concepts and techniques of vector calculus and apply to various real world applications

(iii) To understand the signal processing using Fourier series and transforms

UNIT – 1: Vector calculus: (10 hrs)

Differentiation of vectors – Scalar and vector point functions – Gradient – Directional derivative – Divergence – Curl.

Integration of vectors - Line integral – Circulation - Work done – Surface integral – Flux – Volume integral - Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and their applications.

UNIT – II: Laplace Transforms: (10 hrs)

Definition of Laplace transform - Laplace transforms of standard functions – Properties of Laplace Transforms : Shifting theorems –Transforms of derivatives and integrals – Unit step function – Dirac's delta function – Inverse Laplace transforms – Convolution theorem (with out proof).

Applications: Solving ordinary differential equations (initial value problems) and integro differential equations using Laplace transforms.

UNIT – III: Fourier series and Fourier Transforms: (10 hrs)

Fourier series: Introduction – Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.

Fourier Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Sine and cosine transforms – Properties – inverse transforms – Finite Fourier transforms.

UNIT – IV: Partial differential equations of first order: **(8 hrs)**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

UNIT – V: Second order PDE and Applications: (10 hrs)

Second order PDE: Solutions of linear partial differential equations with constant coefficients – RHS term of the type $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

Applications of PDE: Method of separation of Variables – Solution of One dimensional Wave, Heat and two-dimensional Laplace equation.

Course Outcomes:

The students should be able to:

(i) Interpret the physical meaning of different operators such as gradient, curl and divergence Estimate the work done against a field, circulation and flux using vector calculus

(ii) Apply the Laplace transform for solving differential equations

(iii) Find or compute the Fourier series of periodic signals

(iv) Know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms

(v) Identify solution methods for partial differential equations that model physical processes

Text Books:

(i) **B. S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.

(ii) **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

(i) **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.

(ii) **Dean. G. Duffy,** Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.

(iii) **Peter O' Neil,** Advanced Engineering Mathematics, Cengage.

Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press

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B.Tech III-Semester	THERMODYNAMICS AND KINETICS	L	T	P	C
		3	0	0	3

Course Objective:

1. The student can understand the basic concepts of the properties of a system to help them to get a clear understanding of reversible and irreversible processes.

2. The student can understand the clear concept of enthalpy and internal energy. It also helps in understanding the classification of work.

3. To understand the concepts of free energy and entropy.

4. To know the concepts of activity and equilibrium constants.

5. To understand the kinetics of chemical processes and simultaneous reactions. It helps the student to identify, formulate and solve engineering problems.

UNIT-I

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

UNIT-II

First and Second laws Law of thermodynamics: Nature of first law, relationship between heat and work, internal energy and the first law of thermodynamics, calculations of work, constant capacity, reversible adiabatic processes, reversible isothermal pressure or volume changes of an ideal gas, enthalpy change with temperature, Kirchhoff's equation. Second law of thermodynamics: Efficiency of a cyclic process, Carnot cycle, Carnot theorem, second law of thermodynamics, concept of entropy

UNIT-III

Third law of thermodynamics: Background of third law deductions from third law, applications of third law, and other methods of obtaining ΔS^0 for a reaction. Free energy functions: Purposes of the new functions, definition of Helmholtz and Gibbs free energy change, meaning of thermodynamically possible process, determination of ΔG from thermal data useful relationships between free energies and other thermodynamic functions, Maxwell's equation and Gibbs-Helmholtz equation.

UNIT-IV

Fugacity, activity and equilibrium constant: Concepts of fugacity, activity and equilibrium constant variation of the equilibrium constant with temperature, Calculation of equilibrium constant from free energy changes, derivation of the Clausius – Clapeyron equation for single substance, Duhriges rule for the estimation of the vapour pressures of an element, Integration of Clausius – Clapeyron equation and Problems.

UNIT –V

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

Course Outcomes:

Student will be able

1. To apply the concepts and properties of system in engineering problems.

2. To understand systems concept of manufacturing processes.

3. To understand the relationship between these functions and their applications in various thermodynamic processes.

4. To identify, formulate and solve engineering problems.

5. To understand kinetics, order of a reaction and rate constants.

CO PO Mapping

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4	√	√										
CO5	√	√										

TEXTBOOK:

1. Introduction to the thermodynamics of materials 5th Edition– D.R. Gaskell – CRC Press
2. Principles of metallurgical thermodynamics- S. K. Bose and S.K. Roy, University Press 2014

REFERENCES:

1. Thermodynamics of solids-R.S.Swalin
2. Physical chemistry of metals-L.S.Darken & Gurry
3. Physical Metallurgy Principles – RH Reed hill.
4. Thermodynamics An Engineering Approach – Cengel – Mcgraw-Hill – 7th Edition
5. Fundamentals of thermodynamics-Sonntag et al
6. An Introduction to thermodynamics-Y.V.C.Rao
7. Chemical and Metallurgical thermodynamics – Prasad Krishnakanth – New Age Publications
8. Text Book of Materials and Metallurgical Thermodynamics: Ahindra Ghosh (PHI)

B. Tech (R20) UCEV (Autonomous) ***w.e.f*** **2020-21**

B.Tech III-Semester	FOUNDRY TECHNOLOGY	L	T	P	C
		3	0	0	3

Course objectives*:*

1. To know about various types of foundries and know the patterns and moulding sands and additives used for getting good moulds.

2. To know in detail about various casting processes and properties in moulds. Gating and riser in moulds.

3. Study of different moulding processes and their equipment

4. Solidification of metals and alloys and melting practices to be studied.

5. Various casting defects and their prevention to be studied.

UNIT I

SCOPE AND DEVELOPMENT OF FOUNDRY: types of foundries. Patterns, materials for patterns, types of patterns, functions and pattern allowance.

MOULDING MATERIALS: Moulding sands, properties, selection of materials and additives used.

UNIT II

CASTING PROCESSES AND EQUIPMENT: Green and dry sand moulding; shell moulding, CO_2 moulding. Core moulds and cores. Plaster mould casting, composite mould casting, Investment casting.

GATING AND RISERING: Gate nomenclature, gate types and types of risers, Gating Ratio.

UNIT III

Types of moulding equipment, Permanent mould casting, pressure die-casting, Gravity die-casting and centrifugal casting.

UNIT IV

SOLIDIFICATION OF METALS: Nucleation crystal growth. Freezing of metals and alloys. Dendritic freezing. Coring and segregation, ingot defects, Flow of metals in moulds.

MELTING OF FERROUS ALLOYS: ‘Melting of Gray iron and cupola. Cupola operation and control. Effect on chemical composition, carbon equivalent, and effect of alloying elements on foundry characteristics. Melting of non-ferrous alloys: Melting of Aluminium and copper alloys production processes: Production of Gray Iron, ductile iron. Malleable iron castings

UNIT V

CONTINUOUS CASTING AND CASTING DEFECTS: Casting defects arising due to moulding, coring melting, and poring practice, solidification simulation.

Course Outcomes:

Student will be able

1. To select materials and additives used in moulding and patterns.

2. To understand the concepts of casting processes and gating.

3. To identify types of moulding equipments.

4. To understand soldification of metals and melting of ferrous alloys.

5. *To estimate casting defects.*

CO PO Mapping

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4	√	√										
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

TEXTBOOKS

1. Principles of Metal casting by Heine, Loper, and Rosenthal.
2. Foundry Technology – Dhuvendra Kumar & S.K.Jain

REFERENCE BOOKS

1. Metals Handbook Vol. 5 published by ASM, Ohio.
2. Foundry Technology-Jain
3. Foundry Technology Principles-T.V.Ramana Rao

B.Tech III-Semester	FOUNDRY TECHNOLOGY LAB	L	T	P	C
		0	0	3	1.5

(Learning objective: Design the sequence of operations in a logical order. The relevant tabular forms are to be prepared. Experiments are to be conducted taking the necessary precautions. The data should be recorded and the results need to be interpreted using the necessary mathematical expressions. The graphs are to be drawn where ever required and the appropriate conclusions should be presented.)

LIST OF EXPERIMENTS:

1. Preparation of gating system using green sand.
2. Study of the 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. Founding of Al and Cu alloys in a pit furnace and casting into light components.
9. Study Charge calculations and melting practice of cast iron in a cupola.
10. Preparation of a shell-by-shell moulding process.
11. Non-destructive testing of a few cast-iron components.

Equipment:

1. Mould Boxes, Patterns, Cove 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

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

Parameters - I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

Parameters - II.

At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)

B.Tech III-Semester	MINERAL PROCESSING AND METALLURGICAL ANALYSIS LAB	L	T	P	C
		0	0	3	1.5

(Learning objective: Design the sequence of operations in a logical order. The relevant tabular forms are to be prepared. Experiments are to be conducted taking the necessary precautions. The data should be recorded and the results need to be interpreted using the necessary mathematical expressions.)

List of Experiments

1. Sampling of ore from the bulk by: Coning and quartering method, Riffle sampler methods
2. Sizing by Sieve analysis of crushed ore
3. Determining the reduction ratio of a jaw crusher.
4. Study of the variation of reduction ratio with process variables in Rolls crusher.
5. Study of the process variables on reduction ratio and particle size distribution in ball mill.
6. To find the grindability index of ores.
7. Verification of Laws of Comminution.
8. Determination of the efficiency of a magnetic separator.
9. Determination of the efficiency of a jig.
10. Study of the particle separation by fluid flow using wilfley table.
11. To study the concentration of metallic and non-metallic ores by Froth-Flotation process.
12. Estimation of Iron in Iron ore. - To determine the percentage of Iron in Iron Ore by KMnO4 method and K2Cr2O7 method.
13. Estimation of Copper in Brass by Electrolytic method.
14. Estimation of the concentration of KMnO4 in the solution using Digital Spectrophotometer.
15. Estimation of Sulphur, Phosphorus and Manganese in cast irons
16. Estimation of Mn, Cr, and Si in Ferro-Alloys

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. Pneumatic Separator
12. Froth – Floatation Equipment
13. Electronic digital balances – 2 No's
14. Optical emission spectrometer
15. Flame Photometer

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

Parameters-I.

1. *observation book,*
2. *Record.*

3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

Parameters-II.

1. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

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B.Tech III-Semester	PHYSICAL METALLURGY LAB	L	T	P	C
		0	0	3	1.5

(Learning objective: Design the sequence of operations in a logical order. Experiments are to be conducted taking the necessary precautions. The microstructures should be observed at various magnifications and the structure should be interpreted and conclusions should be presented.)

LIST OF EXPERIMENTS

1. Preparation and study of Crystal models.
2. Study of: Specimen cutting machine Specimen mounting press Grinding and polishing equipment
3. Study of various Metallurgical Microscopes and use of levelling press
4. Metallographic preparation of ferrous specimens for Microscopic examination
5. Preparation of non-ferrous specimens for Metallographic examination
6. Preparation and Metallographic study of pure metals like Iron, Copper, Aluminium, etc..
7. Measurement of lattice parameters of various crystal structures and calculation of packing factors and size of vacancies.
8. Identification of Microstructures of steels
9. ASTM Grain size measurement
10. Second Phase Analysis using Image Analysis

Equipment:

1. Specimen Cutting Machine
2. Specimen Mounting Press
3. Belt Grinding Machine
4. Disc Polishing Machines
5. Metallurgical Microscopes
6. Specimen Leveller.
7. Image analyser
8. Standard samples with their microstructures

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B.Tech III-Semester	Metallurgical Microscopy and image analysis (Skill oriented course)	L	P	C
		1	2	2

(The objectives of this course is to acquire knowledge on the To impart knowledge on basics of image analysis using optical microscope)

UNIT – I

Study of metallurgical microscope, use of filters and Polarized Light in optical microscopy**,** Concept of resolution and magnification

UNIT – II

Importance of Sample Preparation, Incorrect Preparation of the Specimen, Polishing Procedures, Diamond Polishing, Oxide Polishing, Need of Etching, Different Etchants, Types of Etching

UNIT – III

Automated Image Analysis : digital quantitative evaluation of a microstructure image. Doing Quantitative measurements of length, width, area using image analysis software**.** Study of evaluation of grain size, inclusions, layers, and phases or other constituents using image analysis software.

UNIT – IV

Image processing: Removing disturbing information – improving image with software filters to get improve contrast, concept of colour metallography

UNIT – V

Image quantification, Image digitization, Microscopic examination and complete analysis of ferrous and non ferrous metals

Text books :

ASM HANDBOOK ON Metallography And Microstructures

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B.Tech III-Semester	R-20 Syllabus	L	T	P	C
		2	0	0	0
Branch: CE,ME,EEE,ECE,CSE,IT,MET	**Constitution of India**				

Course Objectives:

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
- To understand the central and state relation financial and administrative.

UNIT-I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions;

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

UNIT-IV

A Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation Panchayati Raj: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women

Course Outcomes:

At the end of the semester/course, the student will be able to have a clear knowledge on the following:

- Understand historical background of the constitution making and its importance for building a democratic India.
- Understand the functioning of three wings of the government ie., executive, legislative and judiciary.
- Understand the value of the fundamental rights and duties for becoming good citizen of India.
- Analyze the decentralization of power between central, state and local self-government.
- Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

1. Know the sources, features and principles of Indian Constitution.
2. Learn about Union Government, State government and its administration.

3. Get acquainted with Local administration and Panchayati Raj.
4. Be aware of basic concepts and developments of Human Rights.
5. Gain knowledge on roles and functioning of Election Commission

References:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government andPolitics Hans
7. J. Raj IndianGovernment and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-resources:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details

B. Tech (R20) UCEV (Autonomous) ***w.e.f*** **2020-21**

B.Tech IV-Semester	PRINCIPLES OF EXTRACTIVE METALLURGY	L	T	P	C
		3	0	0	3

Course objectives:

1. *The unit aims to discuss unit processes during the metal extraction*
2. *Deals with different types of roasting processes*
3. *The unit outlines different reduction processes and also discusses the Ellingham diagrams*
4. *The main objective is to describe the principles of leaching and associated hydrometallurgy*
5. *The main objective is to describe the principles of electrometallurgy and electro winning, to describe the methods of refining*

UNIT-I

Introduction: Classification of ores, advantages and disadvantages of unit processes in extractive metallurgy. Calcination.

UNIT-II

Roasting: Types of roasting: Oxidizing, sulphatising and chloridizing, Simple equations/reactions. Roasting furnace: Multiple hearth roaster, flash roasting, fluidized bed roasting, blast roasting. Sintering and pelletisation

UNIT-III

Smelting, smelting furnaces and slags: Principles of reduction and matte smelting with examples. Reverberatory, BF and electric smelting. Flash smelting. Classification, properties importance of Ellingham diagrams for oxides and sulphides and ellinghams limitations.

UNIT-IV

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

UNIT-V

Classification of electrometallurgy, Advantages and disadvantages electrometallurgy. Electrolytic cell-Anodic and cathodic reactions. General discussions on the electrowinnig of metals.
Principles of Refining: Fire refining. Distillation, liquation, electro-refining and zone refining.

Course outcomes:

The students should be able to

1. Understand Basic principles of Extractive metallurgy
2. Understand siginificance of roasting
3. Know Ellingham diagram and its significance
4. Know the Principles of hydrometallurgy, properties of good solvent leaching and precipitation
5. learn principles of electrometallurgy, different types of techniques

CO PO Mapping

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4	√	√										
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (with special focus on academically weak students) at the end of each unit).

Text Book:

1. Non-ferrous extractive metallurgy: H.S Ray, K.P. Abraham and R.Sreedhar
2. Principles of extractive metallurgy-Gosh and Ray – new Age Publishers

Reference Books:

1. Principles of Extractive Metallurgy – F. Habashi – CRC Press

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B.Tech IV-Semester	Elements of Mechanical Engineering	L	T	P	C
		3	0	0	3

Course Objectives:
The students will acquire the knowledge:

1. To understand the concepts of steam boilers and gas turbines
2. To illustrate the knowledge on metal joining, forming, machine tools and casting.
3. To understand the concepts of reciprocating and rotary air compressors.
4. To Understand working principle of internal combustion engines.
5. To Analyze concepts of power transmission by belt, rope, chain and gear trains.

UNIT –I:
Steam boilers: Classification of boilers, essentialities of boilers, selection of different types of boilers, study of boilers, boiler mountings and accessories.

Gas Turbines: Classification, Working principles and Operation of Open cycle and closed cycle gas turbines.

UNIT-II:

Metal joining: arc welding, resistance welding, gas welding, brazing and soldering
Metal forming: forging – operations, rolling and extrusion principles
Machine tools: lathe classification, specifications, and operations.

Casting: Steps involved in making a castings – Advantages and applications – Patterns and Pattern making

UNIT-III:
Reciprocating and rotary air compressors: uses of compressed air, types, working principle, work done, volumetric efficiency, simple problems.

Refrigeration – Refrigerating effect, Ton of Refrigeration, COP. Principle and working of vapour compression refrigeration and vapour absorption refrigeration systems. Properties and classification of refrigerants, commonly used refrigerants.

UNIT-IV:

Internal combustion engines: classification of IC engines, basic engine components and nomenclature, working principle of engines, Four strokes and two stroke petrol and diesel engines, comparison of CI and SI engines, comparison of four stroke and two stroke engines, simple problems such as indicated power, brake power, friction power, specific fuel consumption, brake thermal efficiency, indicated thermal efficiency and mechanical efficiency.

UNIT-V:

Belts –Ropes and chains: belt and rope drives, velocity ratio, slip, length of belt , open belt and cross belt drives, ratio of friction tensions, centrifugal tension in a belt, power transmitted by belts and ropes, initial tensions in the belt, simple problems.

Gears: classification of gears, gear ratio, law of gearing, gear profiles, applications.

Gear trains: classification of gears, gear trains velocity ratio, simple, compound –reverted and epicyclic gear trains.

Text Books:

1. Mechanical Engineering Science K R Gopala Krishna, Subhas publications
2. Thermal Engineering, Ballaney, P.L., Khanna Publishers, 2003
3. Elements of Mechanical Engineering, A.R.Asrani, S.M.Bhatt and P.K.Shah, B.S. Publs**.**
4. Elements of Mechanical Engineering, M.L.Mathur, F.S.Metha & R.P.Tiwari Jain Brothers Publs., 2009**.**
5. Production Technology by P.N.Rao by I & II McGraw-Hill publications

Reference Book:

1. Theory of Machines, S.S. Rattan, Tata McGraw Hil , 2004 & 2009.

Course Outcomes:

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

1. Understand the concepts of steam boilers and gas turbines. (BL-2)
2. Illustrate the knowledge on metal joining, forming, machine tools and casting. (BL-2)
3. Understand the concepts of reciprocating and rotary air compressors. (BL-2)
4. Understand working principle of internal combustion engines. (BL-2)
5. Analyse concepts of power transmission by belt, rope, chain and gear trains. (BL-4)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech IV-Semester	INDUSTRIAL HEAT-TREATMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. *This unit deals with principles of heat treatment, and different hardenability methods.*
2. *To learn about different surface hardening methods.*
3. *This topic throws light on TTT Curves and the effect of alloying elements on Fe-Fe_3C system.*
4. *This topic explains heat treatment of various types of tool, die steels and cast irons.*
5. *To understand the principles of heat treatment of various non-ferrous alloys.*

UNIT-I

Principles Of Heat Treatment: Austenitic Transformation, Pearlitic Transformation, Bainitic Transformation, Martensitic Transformation, Annealing, Normalizing, Hardening, mechanism of heat removal during quenching, quenching media, size and mass effect, hardenability, tempering, au tempering, manufacturing, deep freezing. Industrial Heat treatment furnaces and their design, atmosphere control vacuum heat treatment, etc.

UNIT-II

Surface heat treatment, carburizing, cyaniding, flame and induction hardening, residual stresses, deep freezing, thermomechanical treatments: Low and High temperature thermo mechanical treatments, Au forming, Is forming, Cry forming.

UNIT-III

Effect of Alloy Elements in Heat Treatment: Purpose of alloying, effect of alloying elements on ferrite, cementite, Fe- Fe_3C system, tempering, and TTT Curves.

UNIT-IV

Effect of Heat treatment on Alloy Steels: Structural and constructional steels, maraging steels, tool and die steels. Corrosion and heat resistant steels, Hadfield steels, magnetic steels and alloys, free machining steels.

Effect of Heat treatment on Cast Irons: White cast iron, grey cast iron, spheroidal graphite iron, malleable cast iron, alloy cast iron.

UNIT-V

Heat treatment of Non-Ferrous Metals And Alloys: Precipitation hardening, aging treatment, the study of copper and its alloys, aluminium and its alloys, nickel and its alloys.

Course Outcomes:

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

1. *Modify the microstructure and properties using different heat treatments*
2. *Understand the various types of heat treatment mechanisms to improve the material properties.*
3. *Understand the role of alloying elements and heat treatment*
4. *Understand the effect of heat treatment on Alloy steels and castirons*
5. *Analyze and Understand the effect of heat treatment on Non –ferrous metals and Alloys*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2	√	√	√									
CO3	√	√										
CO4	√	√										
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with grinding focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

TEXTBOOK

1.Heat Treatment Principle and Techniques-Rajan & Sharma
2.Heat treatment of metals- Vijayendra Singh, 2nd edition, Standard Publishers Distributors, 2006

REFERENCES

1.Heat Treatment of metals-Zakharv-Mir Publishers
2.Physical Metallurgy Lakhtin-Mir Publishers
3.Physical Metallurgy - Clark and Varney
4.Physical Metallurgy Principles - Reed Hill
5.Physical metallurgy-Raghavan
6.Materials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley, 2015

B. Tech (R20) UCEV (Autonomous) ***w.e.f*** **2020-21**

B.Tech IV-Semester	CORROSION ENGINEERING	L	P	C
		3	0	3

Course objectives:

1. *To learn about electrochemical principles*
2. *To learn about the Polarization and electrochemical behavior of metals*
3. *To learn the principles and various types of corrosion.*
4. *To learn about various corrosion testing procedures and sequential procedure for laboratory and on-site corrosion investigations*
5. *To understand various protective methods of corrosion.*

UNIT – I

Electrochemical and thermodynamic principles, Nernst equation and electrode potentials of metals, EMF and galvanic series, merits and demerits; origin of Roubaix diagram and its importance to iron, aluminum and magnesium metals

UNIT – II

Exchange current density, polarization- concentration, activation and resistance, Tafel equation; passivity, electrochemical behavior of active/passive metals, theories of passivity

UNIT – III

Atmospheric, pitting, dealloying, stress corrosion cracking, inter granular corrosion, corrosion fatigue, erosion-corrosion, fretting corrosion and high temperature oxidation; hot corrosion; causes and remedial measures

UNIT – IV

Purpose of testing, laboratory, semi-plant and field tests, susceptibility tests for IGC, stress corrosion cracking and pitting, immersion and salt spray testing, impedance analysis, sequential procedure for laboratory and on-site corrosion investigations, corrosion auditing and corrosion map of India

UNIT – V

Corrosion prevention by design improvements, anodic and cathodic protection, metallic, non-metallic and inorganic coatings, mechanical and chemical methods and various corrosion inhibitors

Course Outcomes:

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

1. *Understand the principles of electrochemistry and corrosion*
2. *Understand basics of kinetics of electrochemical corrosion, relevant theories and equations*
3. *origin and causes of high temperature oxidation through their kinetics, governing equations and remedies.*
4. *Different methods of corrosion testing, susceptibility tests, corrosion auditing and map of India.*
5. *Learn Various corrosion preventive methods*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4	√	√		√			√					
CO5			√			√						√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities should by conducting concept tests. Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. Fontana M. G., Greene N.D., 'CorrosionEngineering',2nd Edition, McGrawHill,1983

Reference Books:

1. Raj Narayan, 'An Introduction to Metallic Corrosion and itsPrevention',1stEdition,

Oxford and IBH, 1983

2. Denny Jones, "Principles and Prevention of Corrosion", Prentice Hall of India,1996.

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B.Tech IV-Semester	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:

- The Learning objectives of this paper is to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting
- Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis.
- To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles.
- To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation.
- Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Unit-I

Introduction to Managerial Economics and demand Analysis:

Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

Unit – II:

Theories of Production and Cost Analyses: Theories of Production function- Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.

Unit – III:

Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Business Cycles: Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

Unit – IV:

Introduction to Accounting & Financing Analysis:

Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

Unit – V:

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

Course Outcomes:

- The Learner is equipped with the knowledge of estimating the Demand and demand elasticity for a product
- The knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.
- One is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.
- The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis
- To evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

TEXT BOOKS:

1. Prof.J.V.Prabhakara Rao & Prof.P.Venkata Rao Maruthi Publications

2. S.A.Siddiqui & A.S.Siddiqui New Age International Publishers

REFERENCES:

1. Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand & Company Ltd,

2. JL Pappas and EF Brigham, Managerial Economics, Holt, R & W; New edition edition

3. N.P Srinivasn and M. Sakthivel Murugan, Accounting for Management, S. Chand & Company Ltd,

4. Maheswari S.N, An Introduction to Accountancy, Vikas Publishing House Pvt Ltd

5. I.M Pandey, Financial Management , Vikas Publishing House Pvt Ltd

6. V. Maheswari, Managerial Economics, S. Chand & Company Ltd

7. Mr. Kashi Reddy and Sarawathi, Managerial Economics and Financial Analysis, PHI, 2010 Edition.

B. Tech (R20) UCEV (Autonomous) ***w.e.f*** **2020-21**

B.Tech IV-Semester	CORROSION LAB	L	P	C
		0	3	1.5

(Course objective: This lab course is designed to conduct the experiments on electro deposition, verification of Faraday's laws and evaluation of factors affecting on corrosion)

List of experiments:

1. Study the effect of concentration and temperature on conductivity of an aqueous electrolyte (NaCl)

2. Verification of Faraday's laws

3. Potentio dynamic polarization analysis

4. Impedance analysis.

5. Electroplating of copper/ nickel/chromium

6. To anodise the given aluminum sample and observation of microstructure

7. To understand the principles in galvanic cell corrosion using "Ferroxyl" indicating test solution.

8. To analyze the stress corrosion behavior of steel

9. To study the inter granular corrosion of Austenitic stainless steels

10. To conduct electro polishing of stainless steel using Nitric acid batch

List of equipment:

1.Potentio dynamic polarization unit
2.Stress corrosion analysis unit
3.Rectifier
4.Ammeters
5.Rheostats
6.D C Regulated Power Supply instrument
7. Electro polishing Equipment
8. Multimeters
9. Conductometers
10. Digital weighing balance

Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

Parameters-I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

Paraneters-II.

At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)

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B.Tech IV-Semester	HEAT-TREATMENT LAB	L	T	P	C
		0	0	3	1.5

(Learning objective: Design the sequence of operations in a logical order. The relevant tabular forms are to be prepared. Experiments are to be conducted taking the necessary precautions. The data should be recorded and the results need to be interpreted using the necessary mathematical expressions. The graphs are to be drawn where ever required and the appropriate conclusions should be presented.)

List of Experiments:

1. Annealing of medium carbon steel and observation of microstructure.
2. Normalizing of medium carbon steel and observation of microstructure.
3. Hardening of medium carbon steel and observation of microstructure.
4. Study of tempering characteristics of water quenched steel.
5. Study of age hardening phenomena in duralumin.
6. Spheroidizing of given high carbon steel.
7. Determination of hardenability of medium carbon steel by Jominy end Quench Test.
8. To conduct Re-crystallization studies on cold-worked copper.

Equipment:

1. Muffle Furnaces 1000^0C – 2 No's
2. Muffle Furnaces 300^0C – 2 No's
3. Muffle Furnaces 120^0C – 1 No's
4. Hardenability Apparatus
5. Optical Microscopes
6. Vickers Hardness Tester

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

Parameters-I.

1. observation book,

2. Record.

3. Conduct of the experiment successfully

4. Interpretation of the data

5. Drawing the graphs where ever necessary

6. Viva-voce.

Parameters-II.

1. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

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B.Tech IV-Semester	MECHANICS OF SOLIDS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives: To impart practical exposure on the strength of materials and their properties evaluation. Also to impart practical knowledge on the evaluation of material properties through various destructive testing procedures.

1. Direct tension test
2. Bending test on
   a) Simple supported
   b) Cantilever beam
3. Torsion test
4. Hardness test
   a) Brinells hardness test
   b) Rockwell hardness test
5. Test on springs
6. Compression test on cube
7. Impact test
   a) Izod Test
   b) Charpy Test
8. Punch shear test

Course Outcomes:

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

1. Solve the ultimate stress of mild steel and bending stress for simply supported and cantilever beam. (BL-2)
2. Solve the hardness of different materials and compressive stress on cube (BL-2)
3. Solve the Modulus of rigidity of spring materials (BL-2)
4. Find torsion and punch shear test. (BL-1)
5. Analyze the impact strength for engineering materials. (BL-4)

CO-PO Mapping:

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√			√	√	√	√	√
CO2	√	√	√	√	√			√	√	√	√	√
CO3	√	√	√	√	√			√	√	√	√	√
CO4	√	√	√	√	√			√	√	√	√	√
CO5	√	√	√	√	√			√	√	√	√	√

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech IV-Semester	Advanced Communication Skills Lab	L	T	P	C
		1	0	2	2
(Common to All Branches CE, CSE, ECE, EEE, MECH, IT & MET)					

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To enable the students develop advanced communication skills in English for academic and social purposes.
ii. To make the students to understand the significance of group discussion and various modalities of a group discussion.

iii. To make the students to excel in opinion giving and argue confidently and logically during Debates.

iv. To expose the students to the nuances involved in oral presentation skills and Public Speaking skills.

V. To train the students in job interviews by exposing them to the prerequisites, types, FAQ's and various preparatory techniques in job interviews.

UNIT - I: JAM: Do's and Don'ts of JAM, speaking practice with various topics

UNIT - II: Group Discussion: Importance, modalities, types, do's and don'ts of a GD

UNIT - III: Debate: Importance of a Debate, General rules for participation in debate, Useful phrases, Sample debates-Activities

UNIT - IV: Oral Presentation & public Speaking:

- Make Effective presentations using posters, Flash cards and PPTs
- Tips for making a presentation
- Do's and Don'ts of a presentation
- Dealing with nerves
- Simulated topics/situations for public speaking

UNIT - V: Interview Skills:

- Significance of job interviews
- Understanding preparatory techniques for job interviews
- Know and answer frequently asked questions (FAQs) at job interviews
- Mock interviews

Course Outcomes:

The students should be able to:

i. improve their speaking ability by using context -specific vocabulary.

ii. Learn how to communicate in a group discussion confidently and fluently by using appropriate expressions.

iii. Expose the learners to various speaking activities and enable them to argue logically and develop critical thinking skills.

iv. Apply various techniques for making effective oral presentation skills and improve public speaking skills.

v. acquire employability skills by integrating communication skills and to excel in job interviews

Reference Books:

1. Effective Technical Communication | 2nd Edition Paperback – 27 July 2017. by M. Ashraf Rizvi (Author).
2. Sanjay Kumar and Pushp Lata. ―Communications Skills‖. Oxford University. Press. 2011.
3. Video /you tube links:
   Muniba Mazari, Malala Yousuf Zahi, Abdul Kalam, Steve Jobs, Mark Zuckerberg…

B. Tech (R20) UCEV (Autonomous) *w.e.f* **2020-21**

B.Tech V Semester	MECHANICAL BEHAVIOR OF MATERIALS	L	P	C
		3	0	3

Course objectives:

1. To know the effect of transformation of axes. To understand the concept of stress, strain, principal stress, stress tensors and elastic anisotropy

2. To know the importance of yield criteria and the concept of Mohr's circle

3. To understand the concept of Strengthening mechanism and various methods of Strengthening mechanisms

4. To understand the principle of hardness measurement and types of hardness measurements

5. To know the fundamentals, failure and the factors affecting fatigue and creep.

UNIT –I

Concepts of stress and strain: Definition of stress and strain; transformation of axes, tensor notations; relationship between stress and strain; concepts of principal stress and principal strain; concepts of modulus; Hooke's law and understanding stiffness and compliance tensors; Elastic anisotropy.

UNIT –II

Yielding: Yield criterion; equivalent stress and plastic strain, theoretical shear of perfect crystal; Moh's circle, concept of dislocations and dislocation theory; dislocation interaction; kink and jog; sessile and glissiles, partial dislocations, Thomson tetrahedra.

UNIT –III

Strengthening mechanisms: Work hardening; solid solution strengthening; grain boundary strengthening; ageing; particle hardening; types of reinforcements.

UNIT –IV

Hardness: Types of hardness measurements; comparison among hardness methods and scales; micro-hardness; nano-indentation.

UNIT –V

Fracture, Fatigue and creep: Introduction to Fracture Mechanics, S-N curves; life data presentation; influence of stress; linear elastic fracture mechanics in fatigue, crack growth studies, Paris law, metallurgical aspects of fatigue failure; concepts of remedial methods; stress rupture and creep studies; deformation mechanism maps; super-plasticity; fatigue-creep interaction.

Course Outcomes:

1.Able to apply the concepts of stress and strain
2. Able to apply the concept of yielding phenomena
3. Able to understand various types of strengthening mechanisms
4. Able to understand various types of hardness mechanisms
5. Able to understand the concept of fracture, fatigue and creep

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√			√			√		√
CO2	√	√	√	√			√			√		√
CO3	√	√	√	√			√			√		√
CO4	√	√	√	√			√			√		√
CO5	√	√	√	√			√			√		√

(Assessment: The student should be evaluated based on the assignments and objective tests. both formative and summative assessment procedures are to be adopted. Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. Dieter G.E., Mechanical Metallurgy, McGraw Hill, 1988
2. Thomas H. Courtney, Mechanical Behaviour of Materials, 2nd Edition, Overseas Press India Private Limited

Reference Books:

1. Suryanarayana, Testing of Metallic Materials; Prentice Hall India
2. Dowling N.E., Mechanical Behaviour of Materials, International Edition, contributed by K.Sivaprasad and R.Narayanasamy, 2013, Pearson Education Limited.

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech V Semester	IRON MAKING AND STEEL MAKING	L	T	P	C
		3	0	0	3

Course Objectives:

1.To know about concepts of blast furnace
2. To learn about hot metal and slag reactions
3. To know about various types of iron making
4. To learn about basic concepts of steel making
5. To learn about various types of steel making processes

UNIT-I

Classification of furnaces; different kinds of furnaces, heat balance, energy conservation and energy audit; parts, construction and design aspects of blast furnace, ancillary equipment; blast furnace instrumentation.

UNIT-II

Blast furnace reactions; Gruner's theorem, carbon deposition, the partitioning of solute elements between the Iron and the slag; reactions in blast furnace; blast furnace slags; mass balance and heat balance

UNIT-III

Blast furnace (B/F) operations; B/F irregularities and remedial measures, B/F refractories and causes of failure, modern trends in (B/F) technology overview of direct reduction processes, electric smelting; production of DRI (HBI/ Sponge iron)

UNIT-IV

Review of traditional steel making; physical chemistry and thermodynamics; air/O_2 impurity interaction, slag metal interaction, role of slags in refining, continuous casting; foaming slag; removal of S and P; de-oxidizers, alloying;

UNIT-V

Open hearth F/C; Bessemer converters; bottom blown and top blown processes; slag practices and sequencing; LD, VD, AOD, and VOD; Ladle metallurgy; electric arc furnace and DRI usage; energy, environmental and quality considerations

Course Outcomes:

1.Able to understand the design, accessories and energy calculations of blast furnace
2. Able to understand mass balance and heat balance for various reactions in bf
3. Able to understand alternate routes of iron making
4. Able to understand basic concepts of steel making
5. Able to know the processes of steel making

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√			√			√		√
CO2	√		√	√			√			√		√
CO3	√		√	√			√			√		√
CO4	√		√	√			√			√		√
CO5	√		√	√			√			√		√

(Assessment: The student should be evaluated based on the assignments and objective tests. both formative and summative assessment procedures are to be adopted. Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. Modern Steelmaking, Dr. R.H. Tupkary and V.H. Tupkary
2. A first course in iron and steel making by Deepak Majundar

Reference Books:

1. Steel making by Kudrin V A
2. Making Shaping and Treating of Steels by United States Steel Corporation, Pittsburgh.
3. Open Hearth furnace practice - Bornatsky,
4. Manufacture of Iron and Steel, Vol. II by Gr Bashforth
5. Steel Making: A. K. Chakrabarthi (PHI)

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B.Tech V Semester	WELDING TECHNOLOGY	L	P	C
		3	0	3

Course objectives:

1. *To know the working principle, variables of welding process, microstructure changes in weld zone*
2. *To know the working principle, merits and demerits of fusion welding processes.*
3. *To Understand the working principle and importance of welding allied processes.*
4. *To know the weldability and welding related problems of ferrous materials , various defects of welds.*
5. *To Learn weldability of various Non ferrous alloys*

UNIT – I

The principles and theory, mechanism and key variables of different welding processes, types of tooling and equipment. Microstructure of fusion and heat affected zone, welding stresses, pre and post treatments.

UNIT-II

Advantages, disadvantages and field of application of the welding with reference to the following welding processes, Gas welding, Arc welding, submerged arc welding, TIG, MIG, MAG, CMT ,Plasma arc welding.

UNIT – III

Electron Beam welding , spot-welding, Laser welding, diffusion joining, Friction welding, Friction stir welding, ultrasonic welding and explosive welding, MIAB welding

UNIT-IV

Welding of structural steel, welding of cast iron, welding of stainless steel and other high-alloyed steels. Welding defects and remedies

UNIT-V

Welding of copper and its alloys, welding of aluminium and its alloys, joining of dissimilar alloys mechanism, Techniques and scope of brazing, soldering and adhesive bonding processes.

Course Outcomes:

1: Able to understand welding mechanisms
2. Able to understand different types of welding processes
3. Able to understand modern welding processes
4. Able to understand welding of different materials
5. Able to understand welding mechanism of joining techniques

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√		√				√		√
CO2	√		√	√		√				√		√
CO3	√		√	√		√				√		√
CO4	√		√	√		√				√		√
CO5	√		√	√		√				√		√

(Assessment: The student should be evaluated based on the objective tests. The student's analytical abilities should be tested periodically by giving assignments). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Book:

1. Welding Technology-R.S.Parmar**.**
2. A Textbook welding technology by O.P Khanna
3. Welding and welding technology by R L Little

Reference Books:

1. JF Lancaster: Welding Metallurgy
2. Little: Welding and Welding Technology
3. Agarwal Manghmani: Welding Engineering
4. BE Rossi: Welding Engineering

B. Tech (R20) UCEV (Autonomous) ***w.e.f*** **2020-21**

B.Tech V Semester	INTRODUCTION TO MATERIALS SCIENCE (OPEN ELECTIVE – I)	L	P	C
		3	0	3

Course objectives:

1. *To learn about the fundamentals of crystal structure, defects*
2. *To learn about the fundamentals of dislocations and their interaction*
3. *To learn about the electrical and magnetic Properties of materials*
4. *To learn about the Properties of advance materials*
5. *To learn about the glass and amorphous materials*

UNIT - I

Introduction: classification of materials**,** Space lattice and unit cells,

Crystal systems: Indices for planes and directions. Structures of common metallic materials.

Crystal defects: Point, Line and surface defects. Dislocations, types of dislocations

UNIT – II

Dislocation movement by slip, climb and cross slip. Dislocation sources, dislocation interaction.

Slip systems for BCC, FCC and HCP metals, Critical resolved shear stress (CRSS) for slip, Twinning, Stacking faults, Jogs, Kinks. Strengthening mechanisms

UNIT - III

Electrical and Electronic properties of materials, Electronic conductivity, free electron theory and band theory of solids. Intrinsic semi-conductors. Super conductivity.

Dia, para, ferro, ferri magnetism in materials , Soft and hard magnetic materials and applications.

UNIT - IV

Optical properties of materials. Refractive index, absorption emission of light, optical fibers.Opto-electronic materials.

UNIT-V

Bulk metallic glasses, glass forming ability, quasi crystals, Nano crystalline materials, amorphous materials

Course Outcomes:

Student shall be

1. *Able to understand crystal systems and crystal defects*
2. *Able to understand dislocation mechanisms*
3. *Able to understand electrical, electronics and magnetic nature of materials*
4. *Able to understand the optical properties of materials*
5. *Able to understand the amorphous materials*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√								√		√
CO2	√	√								√		√
CO3	√	√	√	√						√		√
CO4	√	√	√	√						√		√
CO5	√	√	√	√						√		√

Text books:

1. Material Science and Engineering by V.Raghavan
2. Physical Metallurgy by S. H. Avner.

Reference books:

1. Material Science and Engineering by L.H.VanVleck, 5th edition, AddisionWealey(1985)
2. Structure and properties of Materials by R.M.Rose, L.A.Shepard and J.Wulff, Vol.1,4 John Willey (1966) .
3. Essentials of Material Science by A.G.Guy, McGraw Hill(1976).
4. The Science and Engineering Materials by D.R.Askeland. 2nd Edition, Chapman and Hall (1990).
5. Physical Metallurgy, Vijendra Singh

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B.Tech V Semester	BASICS OF CRYSTALLOGRAPHY (OPEN ELECTIVE – I)	L	P	C
		3	0	3

Course objectives:

1. *to learn about the fundamentals of crystal structure and perform relevant numerical calculation*
2. *to study about various diffraction techniques used for crystallography*
3. *To study about the various type of various interstitial solid solution, compounds and intermetallics*
4. *To study the impact of defects on material properties.*
5. *To study about the symmetry and crystallography in crystals*

UNIT – I

Motif, lattices, lattice points, lattice parameter, Crystal systems,14 Bravice lattices, Coordination number, number of atoms per unit cell, packing factor, Miller indices of planes directions, repeat distance, linear density packing factor along a direction, planar density, planar packing fraction

UNIT – II

Usage of diffraction techniques for crystallography- XRD, Neutron Diffraction, and synchrotron diffraction.

UNIT – III

Radius ration for coordination number 2,4,6,8. Interstitial solid solution, Interstitial compounds. AX, AX2, AB03 A 2B04 crystal structures

UNIT – IV

Frenkel-Schkotty ionic defects, Ionic defect concentration, solute incorporation, Electronic defect concentration, Defects and chemical reactions. Symmetry and types of Symmetry in crystals.

UNIT – V

Stereographic projection. Crystallographic point groups, micro translations, symmetry of reciprocal lattice, systematic absences, space groups.

Course Outcomes:

1. *Able to understand basics of crystallography*
2. *Able to Able to understand diffraction techniques*
3. *Able to understand calculations involved in crystal structures*
4. *Able to understand mechanisms of crystal defects*
5. *Able to understand stereographic projection*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√								√		√
CO2	√	√								√		√
CO3	√	√								√		√
CO4	√	√								√		√
CO5	√	√								√		√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning ability should tested by conducting class room tests. Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text books:

1. Introduction to crystallography, Donald E. Sands, Courier Corporation, 2012

Reference books:

1. The science and Engineering Materials, Donald R. Askeland and Pradeep phule, Thmson, 2003
2. Elements of X-ray diffraction, Cullity B.D., Addison-Wesley Publishing company 1956

B. Tech (R20) UCEV (Autonomous) ***w.e.f*** **2020-21**

B.Tech V Semester	METALURGICAL PROCESS MODELLING (OPEN ELECTIVE – I)	L	P	C
		3	0	3

Course objectives:

1. *To know various mathematical models and their advantages*
2. *To differentiate finite element and finite differential modeling.*
3. *know the application of artificial intelligence in various metallurgical problems*
4. *To develop physical models in various metallurgical applications.*
5. *To analyse different case studies related to process modeling.*

UNIT-I

Mathematical modeling, physical simulation, advantages and limitations; process control, instrumentation and data acquisition systems, review of transport phenomena, review of differential equations, review of numerical methods;

UNIT-II

Concept of physical domain and computational domain, assumptions and limitations in numerical solutions, introduction to FEM & FDM, Introduction to software packages – useful websites and generic information about different products - ANSYS, Thermocalc, CFD;

UNIT-III

Introduction to expert systems and artificial intelligence. Demonstration and practical training in some software packages.

UNIT- IV

Physical modeling – cold and hot models; case studies of water models, use of computers for the construction of phase diagrams, alloy design, crystallography, phase transformations and thermo chemical calculations.

UNIT – V

Case studies from literature – pertaining to modeling of solidification / heat transfer, fluid flow, casting, welding and liquid metal treatment

Course Outcomes:

1. *Able to understand what is modelling*
2. *Able to understand software packages*
3. *Able to understand practical knowledge in software packages*
4. *Able to understand physical modelling of materials*
5. *Able to do case studies in metallurgy*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√					√		√
CO2	√	√	√	√	√					√		√
CO3	√	√	√	√	√					√		√
CO4	√	√	√	√	√					√		√
CO5	√	√	√	√	√					√		√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested

periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. Szekely J., Themelis N. J., 'Rate Phenomena in Process Metallurgy', Wiley, 1971
2. P.S. Ghosh Dastidar, "Computer Simulation of Flow and Heat Transfer", Tata McGraw Hill, New Delhi, 1998

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech V Semester	FUELS, FURNACES AAND REFRACTORIES (PROFESSIONAL ELECTIVE -I)	L	T	P	C
		3	0	0	3

Course objectives*:*

1. To study the origin, classification, and analysis of industrial fuels. Manufacture and testing of metallurgical coke along with the properties are to be studied

2. Study of fuel oil production and fuel gases production and their uses

3. Study of heat transfer through various bodies. Solving problems pertaining to them. Study of different furnaces.

4. To study various types of pyrometers used in the industry.

5. To study different types of Refractories, their manufacturer, properties and industrial users.

UNIT I

Introduction to Fuels technology Classification of fuels Origin and classification of coal Analysis of Coal Proximate and ultimate analysis.

Pulverized fuels Principle of Carbonization Manufacture of Metallurgical coke Properties of Metallurgical Coke Testing of Coke.

UNIT II

Principles of production of fuel oils from crude. Manufacture, properties and uses of

a) Producer gas

b) Water-gas Properties and uses of Blast furnace gas and coke oven gas; cleaning of Blast Furnace gas.

UNIT III

Steady-State Heat Transfer: Importance of Heat transfer, conduction through a plane, cylindrical, Spherical and compound walls, shape factor and effect of variable thermal conductivity

Furnaces: Characteristic features of vertical shaft furnaces, reverberatory furnaces, Arc and Induction furnaces. Tube and muffle type resistance furnaces, continuous furnaces. Sources of heat losses in furnaces and heat balance.

UNIT-IV

Pyrometry: Thermoelectric pyrometry- Peltier and Thomas e.m.f's. Thermo-electric power of thermocouples. Required properties of thermocouples. Noble and base metal thermocouples. Thermo-pile. Measurement of e.m.f by Milli-voltmeters and potentiometers. Thermometer; optical and radiation pyrometer.

UNIT V

Refractories: Desirable properties of Refractories. Methods of classification. Modes of failure of refractories in service and their prevention. Manufacturing methods and properties of Fireclay, Silica Magnesite and Chrome-Refractories. Testing of Refractories. Applications of refractories in the metallurgical industries.

Course Outcomes:

1.Able to understand basics of fuel technology related to coal and coke

2. Able to understand the principles of oils and gases

3. Able to understand concept of heat transfer and various types of furnaces

4. Able to understand pyrometry

5. Able to understand refractories

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√									√
CO2	√		√			√						√
CO3	√	√	√	√								√
CO4	√	√	√									√
CO5	√		√			√						√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

TEXTBOOK:

1. Furnaces, Fuels, and Refractoriness by O.P. Gupta, Khanna Publishers.

REFERENCE BOOKS:

1. Elements of fuel technology -HIMUS
2. Refractories Norton
3. Refractories-R.Chisti.
4. Furances-J.D.Gilchrist
5. Pyrometry-W.P.wood& J.M.corck
6. Fuels Furnaces, Refractories& Pyrometry-A.V.K.Surya Narayana.
7. Elements of heat transfer- Jakob&Hawikns.
8. Elements of thermodynamics& heat transfer- Obert & Young.
9. Control systems & Instrumentation S.Bhasker.

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B.Tech V Semester	LIGHT METAL TECHNOLOGY (PROFESSIONAL ELECTIVE -I)	L	T	P	C
		3	0	0	3

Course Objectives*:*

1. *To learn the extraction process, properties, and applications of Al and its alloys.*
2. *To learn the extraction process, properties, and applications of Al and its alloys.*
3. *To learn the properties and applications of Ti and its alloys*
4. *To learn the properties and applications of Mg and its alloys*
5. *To learn the properties and applications of Be and its alloys,Li and its alloys*

UNIT-I

Aluminium and its alloys: Extraction flowsheet processing – Properties – Applications. Wrought and Casting Alloys (Al-Cu, Al-Mn, Al-Si) – Corrosion resistance of Al alloys.

UNIT-II

Aluminium and its alloys: Extraction flowsheet processing – Properties – Applications. Wrought and Casting Alloys (Al-Mg, Al-Si-Mg, Al-Zn, Al-Li) – Corrosion resistance of Al alloys.

UNIT – III

Extraction flow sheet processing –Properties - applications of titanium and its alloys.

UNIT-IV

Magnesium – Classification – Casting alloys – Wrought alloys-properties and applications of Mg alloys.

UNIT-V

Extraction flow sheet processing - properties and applications of Beryllium and Lithium

(Assessment: The student should be evaluated based on the assignments and objective tests. Emphasis should be given by conducting tutorial classes (With a focus on academically weak students) at the end of each unit.)

Course Outcomes:

1.Able to understand Al-Cu, Al-Mn, Al-Si alloys
2Able to understand Al-Mg, Al-Si-Mg, Al-Zn, Al-Li alloys
3. Able to understand Titanium and its alloys
4. Able to understand Magnesium and its alloys
5. Able to understand Beryllium and Lithium

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√			√						√
CO2	√		√			√						√
CO3	√		√			√						√
CO4	√		√			√						√
CO5	√		√			√						√

TEXTBOOK

1. Light alloys: Metallurgy of light metals, I. J. Polmear, 2nd edition, Edward Arnold Publishers, 1989

REFERENCES

1. Light alloys: from traditional alloys to nanocrystals, I. J. Polmear and David St. John, BH- Elsevier, 4th edition 2006
2. ASM Metals Handbook Vol-1 & 2

B.Tech V Semester	FUNCTIONAL MATERIALS (PROFESSIONAL ELECTIVE -I)	L	P	C
		3	0	3

Course objectives:

1. *To learn crystal structure of materials and how structure can be relate to properties*
2. *To understand phenomena of magnetic materials*
3. *To understand the semi conductivity and its applications with respect to materials aspects*
4. *To know about the concepts related to Di electric and ferro electric materials*
5. *To Understand the effect of structures on the properties and applications of Smart materials*

UNIT – I

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

UNIT – II

High Temperature Behaviour of Amorphous and Nanocrystalline Soft Magnetic Materials, Magnetic storage devices to store data using combination of magnetic fields and binary data.

UNIT – III

Basics of semiconductor electrical properties, operation of the semiconductor devices. Semiconductor devices – Theory, examples and applications of optically active materials Band structure, Diode, MOS device capacitor, MOS transistor structure operation, Transistor formation and Transistor isolation

UNIT – IV

Dielectrics, pies and ferroelectric materials, High strain high performance piezo- and ferroelectric single crystals; Electric field-induced effects and domain engineering; Morphotropicphaseboundary related phenomena; High power piezoelectric and microwave dielectric materials; Nanoscalepiezo- and ferroelectrics.

UNIT – V

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

Course Outcomes:

1. Able to understand crystallography of materials
2. Able to understand magnetic nature of materials
3. Able to understand semiconductor electrical properties
4.Able to understand Dielectrics, piezo and ferroelectric materials
5. Able to understand smart materials

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√			√						√
CO2	√		√			√						√
CO3	√		√			√						√
CO4	√		√			√						√
CO5	√		√			√						√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities should be tested periodically in classes by giving problems and by conducting course review class discussions in class)

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 EwaKlodzinska

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B.Tech V Semester	WELDING TECHNOLOGY LAB	L	P	C
		0	3	1.5

(**Course objective:** To give hands-on practice on various arc welding practices, to study the microstructure of welds and to write the welding reports)

List of Experiments:

1. Arc striking practice.
2. Bead-on-plate welding
3. Effect of welding parameters on weld bead
4. GTA welding
5. GMA welding
6. Submerged arc welding
7. Micro structural observation of weldments
   - Carbon steel
   - Stainless steel
   - Aluminium alloys
   - Titanium alloys
   - Dissimilar joints
8. Weld overlaying of austenitic stainless steels on mild steels
9. Practice for preparation of welding procedure specification.
10. Practice for preparation of procedure qualification record.

List of Equipment:

1. Multipower welding source capable of SMAW, SAW, GMAW, GTAW. - 1No
2. Individual power sources and accessories for MMAW - 4 Nos.
3. Metallurgical microscopes - - 4 Nos.

B.Tech V Semester	**MATERIALS TESTING LAB**	**L**	**P**	**C**
		0	**3**	**1.5**

(Course objective: To obtain knowledge on various mechanical testing machines, and mechanical testing methodology.)

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 using micro vickers hardness tester
5. To determine the elastic modulus, ultimate tensile strength, breaking stress, percentage of elongation percentage reduction in area of the given specimen by tensile test.
6. To determine the compressive strength of metals and alloys.
7. To determine the modulus of rigidity of given material by torsion test
8. To determine the Charpy and Izod (V&U Groove notch) impactstrength of a given material at room temperature.
9. To determine the fatigue strength of given material at a given stress
10. To estimate steady state creep rate of materials

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
8. Indentation Creep unit

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:

Parameters-I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

Parameters -II.

At the end of each cycle of experiments internal exams should be conducted in addition to the end examination

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B.Tech V Semester	BASICS OF NON DESTRUCTIVE TESTING (Skill advanced course)	L	P	C
		3	0	3

Course objective: To obtain knowledge on various non destructive testing methods and their working principles

UNIT – I

What is NDT? ,Historical disasters that affected the development of NDT ,NDT Qualification and Certification, Basic overview of 13 NDT methods , Abbreviations of those methods

UNIT – II

Visual Testing (VT) Advantages and Limitations of VT ,VT Qualification and Certification,Welding Gages for VT , Direct and Indirect VT ,Performing VT

UNIT – III

Magnetic particle testing, Basic theory of magnetism, Magnetization methods,Field indicators, Particle application, Inspection

UNIT - IV

Ultrasonic Testing: Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations.

UNIT – V

Leak and pressure testing: Definition of leak and types, Principle, Various methods of pressure and leak testing, Application and limitation

Text books:

1. Non-Destructive Testing by P. Halmshaw

Reference Books:

1. Metals Handbook Vol.II, Nondestructive inspection and quality control
2.Practicalnon destructive testing by Dr.Baldev Raj

B.Tech V Semester	R-20 Syllabus	L	T	P	C
		2	0	0	0
Branch: CE,ME,EEE,ECE,CSE,IT,MET	**Essence of Indian Traditional Knowledge**				

Objectives:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
- The course aim of the importing basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledge system
- To understand the legal framework and traditional knowledge and biological diversity act 2002 and geographical indication act 2003.
- The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection.
- To know the student traditional knowledge in different sector.

Unit-I:

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

Unit-II:

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Unit-III:

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.

Unit-IV:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

Unit-V:

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the concept of Traditional knowledge and its importance
2. Know the need and importance of protecting traditional knowledge
3. Know the various enactments related to the protection of traditional knowledge.
4. Understand the concepts of Intellectual property to protect the traditional knowledge
5. Evaluate food security and protection of TK in the country.

Reference Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, PratibhaPrakashan 2012.
3. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
4. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

E-Resources:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2.http://nptel.ac.in/courses/121106003/

B.Tech VI-Semester	MATERIALS CHARACTERIZATION	L	P	C
		3	0	3

Course objective:

1. *To understand various characterization techniques for solids*
2. *To understand more characterization techniques.*
3. *To understand Electron microscopy methods of characterization*
4. *To know the Diffraction methods of characterization with focus on XRD*
5. *To learn different thermal methods of characterization*

UNIT –I

Introduction: classification of techniques for characterization, macro and micro-characterization structure of solids.

UNIT –II

Raman spectroscopy technique ,**Optical microscopy**: Optical metallography,sample preparation, image analysis,

UNIT –III

Electron microscopy: Scanning electron microscopy, TEM, EDS and WDS.

Other microscopy techniques: AFM and STM

UNIT –IV

Diffraction Methods: X-ray diffraction (crystal systems and space groups, Bravais lattices, direct and reciprocal lattice, Bragg law, powder diffraction and phase identification, single crystal diffraction, structure factor, X-ray crystal structure determination).

UNIT –V

Bulk Averaging Techniques: Thermal analysis, DTA, DSC, TGA, dilatometry.

Course Outcomes:

1. Able to understand classification of characterization techniques
2. Able to understand Optical microscopy and spectroscopy
3. Able to understand microscopic techniques
4. Able to understand X-ray diffraction methods
5. Able to understand bulk averaging techniques

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√	√	√						√
CO2	√		√	√	√	√						√
CO3	√		√	√	√	√						√
CO4	√		√	√	√	√						√
CO5	√		√	√	√	√						√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities should be tested periodically in by concept based tests. Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. The Principles of metallogrphy laboratory practices –George L.Khel-Eurasia publishing house (Pvt Ltd)
2. Transmission electron Microscopy of metals –Garet Thomas.-John wiley and sons.

Reference Books:

1. Modern Metallographic Techniques & their application – victor phillips.
2. Physical Metallurgy, Part – I – RW Chao and P. Haasan.
3. Experimental Techniques in Physical Metallurgy – VT Cherepin and AK Mallik.
4. Electron Microscopy in the study of materials –P.J.Grundy.

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B.Tech VI-Semester	POWDER METALLURGY	L	P	C
		3	0	3

Course objectives:

1. To get acquainted with the importance of powder metallurgy and to know the advantages of PM techniques over other fabrication techniques

2. To get acquainted with various powder production methods and also get an idea of powder characterization.

3. To study the mechanism of compaction and sintering.

4. To gain knowledge on various applications of powder metallurgy parts.

5. To get acquainted with the advanced powder metallurgy materials.

UNIT – I

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

UNIT – II

Characterization and production of powders: General characteristics of metal powders, particle shape flow rate, apparent density, and specific surface area, particle size distribution.

Determination of powder characteristics; different methods of production of metal powders: influence of manufacturing process on powder characteristics.

UNIT – III

Consolidation of Metal Powders: Compaction - Theory of consolidation: Pressure transmissioninpowders; compressibility and compactibility of powders; Green strength; Powder rolling. Sintering - Mechanisms of Sintering; Factors affecting sintering; Activated sintering; Liquid phase sintering; Sintering atmospheres; Properties of sintered parts, Hot isostatic pressing , spark plasma sintering. Properties of sintered parts.

UNIT – IV

Applications: Porous parts: Self-lubricating bearings, filters: Dispersion strengthened materials: Cu /Al2O3, Sintered Aluminium Powder.

UNIT –V

Electrical and Magnetic materials, Tungsten lamp filaments, electrical contacts, welding electrodes. Soft magnetic materials (Fe, Fe-N); Permanent magnets (Alnico, SnCo5), Cemented carbides; Cermets.

Course Outcomes:

1. Able to understand importance of powder metallurgy

2. Able to understand production and characteristics of powders

3. Able to understand compacting and sintering powders

4. Able to understand applications of powder metallurgy

5. Able to understand making of different types of powder metallurgy components

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√					√						√
CO2	√				√	√						√
CO3	√		√	√		√						√
CO4	√		√	√		√						√
CO5	√		√	√		√						√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's understanding should be tested periodically in classes).

Text Books:

1. Powder Metallurgy: Anish Upadhya and GS Upadhya- University Press, 2013
2. Powder Metallurgy, P.C. Angelo and R. Subramanian, PHI Pvt. Ltd., 2008
3. Powder Metallurgy and particulate materials processing by RM German

References Books:

1. Powder Metallurgy, ASM Metals Hand Book , Vol. 7, 1984
2. Powder Metallurgy Science, Randall M. German, 1994

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B.Tech VI-Semester	METAL FORMING	L	P	C
		3	0	3

Course Objectives:

1. To understand basic concepts of yield criteria and theories of failure to develop solutions of material behaviour under varied loading conditions

2. To study mechanics of metal working and understand material flow behaviour under different service conditions in metal forming. It also makes the students to understand the role of friction and lubrication in development of residual stresses during deformation

3. To understand operations of various forging equipment and principles of variety of forging operations. To understand effect of various process parameters during rolling operations and determination of rolling loads that help in designing proper roll mills with improved product yields

4. To understand extrusion and drawing processes and analyze the processes to develop optimal process parameters for a defect free product

5. To make the students aware of specialized forming processes and their specific applications to improve their analytical and simulation skills

UNIT – I

STRESS TENSOR AND YIELD CRITERIA: state of stress, components of stress, symmetry of stress tensor, principal stresses, stress deviator, Von Mises, Tresca yield criteria, comparison of yield criteria, Octahedral shear stress and shear strain, Forming load calculations.

UNIT – II

FUNDAMENTALS OF METAL FORMING: Classification of forming processes, Mechanics of metal working, Flow stress determination, Effect of temperature, strain rate and metallurgical structure on metal working, Friction and lubrication. Deformation zone geometry, Workability.

UNIT – III

FORGING: Forging-types of presses and hammers, Classification, Open die forging and closed die forging, forging in plane strain, forging defects- causes and remedies, residual stresses in forging.

ROLLING: Classification of rolling processes, types of rolling mills, hot and cold rolling, rolling of bars and shapes, forces and geometrical relationship in rolling, analysis of rolling load, torque and power, rolling mill control, rolling defects - causes and remedies.

UNIT – IV

EXTRUSION AND DRAWING : Direct and indirect extrusion, variables affecting extrusion, deformation pattern, equipments, design of extrusion die, hydrostatic extrusion, defects and remedies, Analysis of extrusion force, tube extrusion and production of seamless pipe and tube. Drawing of rods, wires and tubes**.**

UNIT – V

Sheet Metal Forming and Other Processes: Forming methods - Shearing, blanking, bending, deep drawing. Types of dies used in press working, defects in formed part and remedial measures, sheet metal formability, formability limit diagram. High Velocity forming techniques – Electromagnetic forming, electro hydraulic forming, explosive forming

Course outcomes*:*

The student should be able to

1. *Understand elements of plastic deformation which is required as a pre-requisite for studying fracture mechanics course*
2. *Design press tools which are essential for hot and cold working*
3. *understand forging and rolling*
4. *understand extrusion and drawing*
5. *understand sheet metal forming and other processes*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										√
CO2	√	√										√
CO3	√		√	√		√						√
CO4	√		√	√		√						√
CO5	√		√	√		√						√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested periodically in classes. Unit tests are to be conducted at the end of each unit).

Text Books

1 Dieter.G.E ., "Mechanical Metallurgy", McGraw-Hill Co., SI Edition, 1995.
2 Nagpal.G.R., "Metal Forming Processes", Khanna Pub., New Delhi, 2000.

References

1 Kurt Lange "Handbook of Metal Forming", Society of Manufacturing Engineers. Michigan, USA, 1988
2 Avitzur, "Metal Forming - Processes and Analysis", Tata McGraw-Hill Co., New Delhi, 1977.
3 ASM Metals Handbook. Vol.14, "Forming and Forging", Metals Park, Ohio, USA, 1990.
4 Taylor Altan, Soo I.K. Oh, Harold.L.Gegel. "Metal Forming: Fundamentals and Applications", ASM, Metals Park, Ohio, USA, 1983.

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B.Tech VI-Semester	NON DESTRUCTIVE TESTING AND EVALUATION (PROFESSIONAL ELECTIVE – II)	L	P	C
		3	0	3

Course objective:

1. To understand the various non-destructive techniques for testing and inspection of materials to detect surface defects

2. To understand the various non-destructive techniques for testing and inspection of materials to detect sub-surface defects

3. To understand the various non-destructive techniques for testing and inspection of materials to detect internal defects

4. To understand the various non-destructive techniques for testing and inspection of materials to detect sub-surface defects

5. To understand the various non-destructive techniques for testing and inspection of materials to detect internal defects

UNIT – I

Visual Inspection: Visual Inspection- tools, applications and limitations. Liquid Penetrant Inspection - principles, types and properties of penetrants and developers. Advantages and limitations of various methods of LPI. Magnetic particle inspection- principles, applications, advantages and limitations

UNIT – II

Ultrasonic testing: Ultrasonic testing(UT) - Nature of sound waves, wave propagation - modes of sound wave generation - Various methods of ultrasonic wave generation, types of UT Principles, applications, advantages, limitations, A, B and C scan - Time of Flight Diffraction (TOFD)

UNIT – III

Radiography: Radiography testing (RT) – Principles, applications, advantages and limitations of RT. Types and characteristics of X ray and gamma radiation sources, Principles and applications of Fluoroscopy/Real-time radioscopy - advantages and limitations - recent advances.

UNIT - IV

Eddy current testing: Eddy current testing - Principles, types, applications, advantages and limitations of eddy current testing.

UNIT – V

Thermography: Thermography - Principles, types, applications, advantages and limitations. Optical & Acoustical holography- Principles, types, applications, advantages and limitations. Case studies: weld, cast and formed components.

Course Outcomes:

1. Able to understand visual inspection

2. Able to understand Ultrasonic testing

3. Able to understand Radiography

4. Able to understand Eddy current testing

5. Able to understand Thermograph

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√						√		√
CO2	√	√	√	√	√					√		√
CO3	√	√	√	√	√	√				√		√
CO4	√	√	√	√	√	√				√		√
CO5	√	√	√	√	√	√				√		√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning ability should be developed by making them study some case studies)

Text books:

1. Non-Destructive Testing by P. Halmshaw

Reference Books:

1. Metals Handbook Vol.II, Nondestructive inspection and quality control
2. Practical non destructive testing by Dr.Baldev Raj

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B.Tech VI-Semester	BIO-MATERIALS (PROFESSIONAL ELECTIVE – II)	L	P	C
		3	0	3

Course Objectives:

1. *To learn history and common use of biomaterials*
2. *To understand common use of metals, ceramics as biomaterials*
3. *To understand common use of polymers as biomaterials*
4. *To know about the materials used for dental applications*
5. *To understand about the advanced bio materials used for specific applications*

UNIT – I

Introduction: Historical background, construction materials, impact of biomaterials, strength of biological tissues, performance of implants, tissue response to implants, interfacial phenomena, safety and efficacy testing

UNIT – II

Metallic and Ceramic materials: Stainless steels, Co-Cr alloys, Ti-based alloys, Nitinol, biological tolerance of implant metals, ceramic implant materials, alumina, Zirconia, hydroxyapatite, glass ceramics , restorable ceramics, composites, Degradation of Materials in the biological environment, degradation effects on metals and ceramics,

UNIT – III

Polymeric implant materials: Polymers in biomedical use, polyethylene, polypropylene, acrylic polymer, hydrogels, polyurethans, polyamides, biogradable synthetic polymers, silicon rubber, microorganisms in polymeric implants, polymer sterilization, Chemical and biochemical degradation of polymers,

UNIT – IV

Dental Materials: Tooth composition and mechanical properties, impression materials, bones, liners, and varnishes for cavities, filling and restorative materials, oral implants, use of collagen in dentistry.

UNIT – V

Cardiovascular and Orthopedic implants: Artificial heart, aorta and valves, geometry of circulation, vascular implants, cardiac pace makers, bone composition and properties, fracture healing, joint replacement, knee joint repair, bone regeneration with restorable materials.

Course Outcomes:

1.Able to understand importance of bio-materials
2. Able to understand metallic and ceramic materials behaviour in biological environment
3. Able to understand polymeric implant materials behaviour in biological environment
4. Able to understand dental materials
5. Able to understand Cardiovascular and Orthopaedic implants

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√		√				√		√
CO2	√		√	√		√				√		√
CO3	√		√	√		√				√		√
CO4	√		√	√		√				√		√
CO5	√		√	√		√				√		√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities should be tested periodically in classes by using class room assessment techniques)

Text Books:

1. Bhat, S.V., Biomaterials, 2nd edition reprint 2010, Narosa Publishing House
2. Park J.B. and Lakes R.S., Biomaterials: An Introduction, 3rd edition, Springer press , 2007

Reference Books:

1 Park J.B. and Bronzino J.D., Biomaterials: Principals and Applications, CRC Press, 2003
2 Park J.B., Biomaterials Science and Engineering, Springer Press 1984
3 Rattner B.D., Hoffman A.S, Schoen F.J., Lemons J.E., Biomaterials Science: An Introduction
to Materials in Medicine, Academic Press 2004

B.Tech VI-Semester	POLYMER SCIENCE AND TECHNOLOGY (PROFESSIONAL ELECTIVE-II)	L	P	C
		3	0	3

Course objective:

1. *To understand Different kind of polymers and their properties*
2. *To learn classification of polymers and Concept of Molecular Weight and distribution*
3. *To understand the role of additives used in polymers*
4. *To understand thermo plastic and thermosetting polymers*
5. *To learn the processing methods of polymers uses of various important polymers*

UNIT-I

Introduction to polymers and plastics: Conception of polymers, formation of polymers, types of polymers reactions such as addition and condensation, Mechanism of polymerization - Thermoplastic and Thermosetting materials methods of polymerization. Natural rubbers and synthetic rubbers

UNIT –II

Polymeric structure, raw materials and properties - Classification of polymers, raw materials for polymers and their sources. Brief study of structure of polymers and properties.Crystallinity of polymeric materials, effect of time, temperature, catalysts and solvents on polymer properties, molecular weight of polymers.

UNIT – III

Functions of the following types of additives used in Polymers
fillers,lubricants,reinforcingagents,plasticizers,stabilizers,antioxidants,inhibitors,promoters,catalysts,retarders,limitators,colorants, cross-linking agents, blowing agents, photodegradiants, bio-degradiants, laminated polymers.

UNIT- IV

Thermo plastics -Methods of addition polymerization, raw materials, manufacturing methods, properties and uses of the Important Thermoplastic Polymers
Thermosetting resins - Methods of condensation polymerization, raw materials, manufacturing method, properties and uses of the important Thermosetting Polymers.

UNIT – V

Raw materials, manufacturing methods, properties and uses of the following plastics Acetals, Nylons, Polymethyl, Methocrylate (PMMA), Saturated polyesters – PETP and PC, Cellulose acetate and viscose rayon.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities should be tested periodically in classes by using class room assessment techniques)

Course Outcomes:

1. *Able to understand basics of polymers and plastics*
2. *Able to understand polymeric materials*
3. *Able to understand additives used in polymers*
4. *Able to understand thermo plastics and thermo setting resins*
5. *Able to understand manufacturing and properties of plastics*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√								√
CO2	√		√	√								√
CO3	√		√	√								√
CO4	√		√	√								√
CO5	√		√	√								√

Text Books:

1. The elements of polymer science and engineering, Rudin A, Academic Press, 3rd edition, 2013
2. Introduction to polymers, R.J. Young and P. A. Lovell, CRC Press, 3rd edition , 2013

Reference Books:

1. Polymers hand book, J, Brandrup and E. H. Emmergut Wiley-Interscience 4th edition, 1999
2. Material Science and Metallurgy for Engineers –V.D.Kodgire and S. V. Kodgire, Everest Publishers, 2011
3. Callister's Mateials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley, 2015

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B.Tech VI-Semester	FATIGUE AND FRACTURE MECHANICS (OPEN ELECTIVE – II)	L	P	C
		3	0	3

Course objectives:

1. *To know basic mechanisms of fatigue behaviour and effect of stress concentration*
2. *To know about the effect of low cycle and high cycle fatigue on materials*
3. *To learn the fatigue fracture phenomenon, crack initiation and growth*
4. *To understand fracture mechanics and concept of fracture toughness*
5. *To know how to e*valuate and analyze the *life of material by testing and good design*

UNIT – I

Fatigue of structures, S-N curves, Endurance limits, Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams, Notches and stress concentrations, Neuber's stress concentration factors, Plastic stress concentration factors, Notched S.N. curves, Fatigue of composite materials.

UNIT - II

Statistical aspects of fatigue behaviour, low cycle and high cycle fatigue, Coffin-Manson's relation, Transition life, cyclic strain hardening and softening, Analysis of load histories, Cycle counting techniques, Cumulative damage, Miner's theory, Other theories.

UNIT - III

Physical aspects of fatigue Phase in fatigue life, crack initiation, crack growth, final Fracture, Dislocations, fatigue fracture surfaces.

UNIT - IV

Fracture mechanics, strength of cracked bodies, potential energy and surface energy, Griffith's theory, irwin-orwin extension of Griffith's theory to ductile materials, stress analysis of cracked bodies, effect of thickness on fracture toughness, stress intensity factors for typical geometries.

UNIT - V

Fatigue design and testing , safe life and Fail-safe design philosophies, Importance of Fracture Mechanics in aerospace structures, application to composite materials and structures.

Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Course Outcomes:

1. Able to understand fatigue behaviour
2. Able to understand statistical aspects of fatigue behaviour
3. Able to understand different stages of fatigue behaviour.
4 Able to understand theories involved in fracture mechanics
5. Able to understand fatigue design and testing in applications

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√			√								√
CO2	√			√								√
CO3	√			√								√
CO4	√			√								√
CO5	√			√								√

TEXT BOOKS:

1. Barrois W, Ripely, E.L., "Fatigue of aircraft structure," Pergamon press. Oxford, 1983.
2. Prasanth Kumar, "Elements of fracture mechanics", Wheeter publication, 1999.

REFERENCES:

1. KareHellan, 'Introduction to Fracture Mechanics', McGraw Hill, Singapore,1985
2. Knott, J.F., "Fundamentals of Fracture Mechanics," - Buterworth& Co., Ltd., London, 1983.
3. Sih C.G., "Mechanics of fracture." Vol - I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.

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B.Tech VI-Semester	HIGH TEMPERATURE MATERIALS (OPEN ELECTIVE-II)	L	P	C
		3	0	3

Course objectives:

1. To Understand the Creep phenomena at elevated temperature
2. To understand oxidation and corrosion effect on materials due to elevated temperatures
3. To know properties of different alloy steels and to understand how they are used for high temperature applications
4. To know properties of different super alloys
5. To Understand the effect of thermal barriers coatings

UNIT- I

CREEP: Introduction to Creep, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate. Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

UNIT –II

OXIDATION AND HOT CORROSION

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT-III

HIGH TEMEPRATURE STEELS

Cr-Mo Steels,Cr-Mo-V Steels, Austentic Stainless Steels, Ferritic steels for Irradiation damage control, ODS Steels Processing ,Properties and Applications

UNIT-IV

SUPERALLOYS

Iron base, Nickel base and Cobalt base superalloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, Embrittlement, solidification of single crystals.

UNIT –V

CERAMICS AND THERMAL BARRIER COATINGS

Alumina, Zirconia, Silicon carbide, Silicon Nitiride, Glass Ceramics

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities should be tested periodically in classes by giving problems and by conducting course review class discussions in class)

Course Outcomes:

1. Able to understand creep phenomena
2. Able to understand oxidation and hot corrosion
3. Able to understand high temperature steels
4. Able to understand superalloys
5. Able to understand ceramics and thermal barrier coatings

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√			√								√
CO2	√			√								√
CO3	√			√								√
CO4	√			√								√
CO5	√			√								√

Text Books:

1. Callister's Mateials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley, 2015
2. Courtney T.H, "Mechanical Behaviour of Materials", McGraw-Hill, USA, 1990.

Reference Books:

1. G. W. Meetham and M. H. Van-de-Voordee, Materials for high temperature applications, Springer 2000
2. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985.
3. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.

Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1983

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B.Tech VI-Semester	MATERIALS TESTING (OPEN ELECTIVE-II)	L	P	C
		3	0	3

Course objectives:

1. *The topic deals with various types of dislocations, slip and twinning*
2. *To understand the principles of various hardness tests and theories of fracture*
3. *To understand the principle of tensile test, compression Test etc*
4. *To know the fundamentals, failure and the factors affecting fatigue and creep.*
5. *To know the non-destructive testing methods and evaluation of flaws in materials*

UNIT- I

Metallurgical Fundamentals: Critical resolved shear stress. Defects in crystalline materials The concept and types of dislocation, Interaction between dislocations, sessile dislocation, glissile dislocation, Energy of a dislocation, dislocation climb, Jogs, Forces on dislocations. Frank Reed source, slip and twinning.

UNIT- II

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

Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, , significance of transition temperature curve, Metallurgical factors affecting on transition temperature, temper embrittlement.

UNIT – III

Tension Test: Mechanism of elastic action, linear elastic properties. Engineering stress strainand True stress-strain curve. Tensile properties, conditions for necking, effect of temperature and strain rate on tensile properties.

Compression Test: Elastic and in-elastic action in compression, elastic and in-elastic properties in compression.

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.

Creep Test: 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.

UNIT- V

Non-Destructive Tests: Introduction, various NDT methods, applications advantages of one test over the other.

(Assessment: The student should be evaluated based on the assignments and objective tests. The student learning abilities should be tested by classroom assessment techniques.)

Course Outcomes:

1. *Able to understand deformation behaviour with respect to metallurgical fundamentals*
2. *Able to understand Hardness testing and Impact testing*
3. *Able to understand tension test and compression testing*
4. *Able to understand fatigue test and creep test*
5. *Able to understand non destructive testing*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√											√
CO2	√	√		√	√							√
CO3	√	√		√	√							√
CO4	√	√		√	√							√
CO5	√	√		√	√							√

Text Books:

1. Mechanical Metallurgy - GE Dieter

Reference Books:

1. Engineering Materials Science - CW Richards
2. Mechanical behaviour of material-A.H.Courteny
3. Mechanical behavior-Ed.Wulf.

B.Tech VI-Semester	MATERIALS CHARACTERIZATION LAB	L	P	C
		0	3	1.5

(**Course objective:** To enable the students to understand about the principles of materials characterization.)

List of Experiments:

1. Optical microscopy – observing bright field and dark field imaging through optical microscope
2. Optical microscopy – grain size measurement
3. Optical microscopy- inclusion analysis in steel
4. X-ray diffractrometry- phase identification
5. X-ray diffractrometry- crystal structure determination and precise lattice parameter measurement
6. X-ray diffractrometry- crystallite size and lattice strain measurement
7. Electron microscopy-fractography analysis
8. Electron microscopy-BSE imaging in composite microstructures
9. Microchemical analysis using EDS
10. Thermal analysis- TG, DTA and DSC analysis for determining thermodynamic parameters

List of Equipment:

1. Metallurgical microscope with image analysis 1 No.
2. X-ray diffractometer 1 No.
3. Scanning electron microscope with energy dispersive X-ray spectrometer 1 No.
4. Simultaneous thermal analyser 1 No.

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B.Tech VI-Semester	METAL FORMING LAB	L	P	C
		0	3	1.5

(Course Objective: To enable the students to understand the principles and practice of metal forming.)

LIST OF EXPERIMENTS:

1. Tension test - finding out n and k
2. Cold rolling of aluminium and brass sheets
3. Recrystallisation annealing of cold worked alloys
4. Hammer forging
5. Upset forming using Hydraulic Press
6. Simulation of metal flow using a model material
7. Identification of defects in Wrought alloys
8. Macrostructure of Wrought materials
9. Microstructure of Cold worked and hot worked metals
10. Analysis of friction behaviour in sheet metal forming

LIST OF EQUIPMENTS

1.	Hounsfield tensometer	
2.	Cold rolling mill	1 No.
3.	Muffle furnace	1 No.
4.	Forging hammer	1 No.
5.	Hydraulic press	1 No.
6.	Metallurgical microscope	1 No.
7.	Various die sets	1 Set
8.	DC regulated power supply	1 No
9.	Stereo microscope	1 No
10.	Sieve shaker with sieve set	1 No
11.	Hall flow meter	1 No

(Assessment: The student's performance should be evaluated at the end of each class based on the following parameters:
Parameters-I.

1. *observation book,*
2. *Record.*
3. *Conduct of the experiment successfully*
4. *Interpretation of the data*
5. *Drawing the graphs where ever necessary*
6. *Viva-voce.*

Parameters-II.

1. *At the end of each cycle of experiments internal exams should be conducted in addition to the end examination)*

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B.Tech VI-Semester	POWDER METALLURGY LAB	L	P	C
		0	3	1.5

(Course Objective: To enable the students to understand the principles and practice of powder metallurgy.)

LIST OF EXPERIMENTS:

1. To Study Various Characteristics of copper Powders and Evaluate Green Density
2. To find as well as Strength Characteristics (hardness) of Cold-compacted and sintered compact
3. To study the behaviour of metal powder during Conventional and Microwave Sintering of Particulate Compacts
4. To study the behaviour of ceramic powder during Conventional and Microwave Sintering of Particulate Compacts
5. Production of metal powders
6. Seperation of particles using sieve analysis
7. Determination of apparent and tap densities
8. Determination of flow rate of metal powders
9. Hardness of sintered product
10. Mechanical milling using ball mill
11. Mechanical alloying using high energy ball mill

LIST OF EQUIPMENTS

1. Hall flow meter
2. High Energy ball mill
3. Ball mill
4. Sintering furnace
5. Compaction press
6. Hot Isostatic Press

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B.Tech VI-Semester	Artifical Intelligence **(Skill advanced course)**	**L**	**P**	**C**
		1	2	2

Preamble

The aim of this course is to study the AI techniques such as neural networks and fuzzy systems. The course focuses on the application of AI techniques to Metallurgical engineering.

Learning Objectives

- To study various methods of AI
- To study the models and architecture of artificial neural networks.
- To study the ANN paradigms.
- To study the fuzzy sets and operations.
- To study the fuzzy logic systems.
- To study the applications of AI.

UNIT–I

Introduction to AI techniques: Introduction to artificial intelligence systems– Humans and Computers – Knowledge representation – Learning process – Learning tasks – Methods of AI techniques.

UNIT–II

Neural Networks: Organization of the Brain – Biological Neuron – Biological and Artificial neuron Models, MC Culloch-pitts neuron model, Activation functions, Learning rules, neural network architectures- Single-layer feed-forward
networks:– Perceptron, Learning algorithm for perceptron- limitations of Perceptron model

UNIT–III

ANN paradigm: Multi-layer feed-forward network (based on Back propagation algorithm)– Radial-basisn function networks- Recurrent networks (Hopfield networks).

UNIT – IV

Classical and Fuzzy Sets: Introduction to classical sets – properties – Operations and relations – Fuzzy sets –Membership – Uncertainty – Operations – Properties – Fuzzy relations – Cardinalities – Membership functions.

UNIT–V

Fuzzy Logic System Components :Fuzzification – Membership value assignmen – Development of rule base and decision making system – Defuzzification to crisp sets – Defuzzification methods – Basic hybrid system.

Text Books

- Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by S.Rajasekaran and G.A. Vijayalakshmi Pai – PHI Publication.
- Fuzzy logic with fuzzy applications- by T.J. Ross, TMH.

Reference Books

- Introduction to Artificial Neural Systems – Jacek M. Zurada, Jaico Publishing House, 1997.
- Fundamentals of Neural Networks Architectures, Algorithms and Applications – by laurene Fausett, Pearson.
- Neural Networks, Algorithms, Applications and programming Techniques by James A. Freeman, David M. Skapura.
- Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S Sumathi, S N Deepa TMGH

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B.Tech	R-20 Syllabus	L	T	P	C
		2	0	0	0
Branch: CE,ME,EEE,ECE,CSE,IT,MET	**Professional Ethics & Human values**				

Course Objectives:

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty
- To appreciate the rights of others.
- To create awareness on assessment of safety and risk
- Provide depth knowledge on framing of the problem and determining the facts, provide depth knowledge on codes of ethics.

Unit I: Human Values:

Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others –Living Peacefully –Caring –Sharing –Honesty -Courage-Cooperation–Commitment – Empathy –Self Confidence Character –Spirituality.

Unit II: Engineering Ethics:

Senses of 'Engineering Ethics-Variety of moral issued –Types of inquiry –Moral dilemmas –Moral autonomy –Kohlberg's theory-Gilligan's theory-Consensus and controversy –Models of professional roles-Theories about right action-Self-interest -Customs and religion –Uses of Ethical theories –Valuing time –Cooperation –Commitment.

Unit III: Engineering as Social Experimentation

Engineering As Social Experimentation –Framing the problem –Determining the facts –Codes of Ethics –Clarifying Concepts –Application issues –Common Ground -General Principles –Utilitarian thinking respect for persons

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UNIT IV: Engineers Responsibility for Safety and Risk:

Safety and risk –Assessment of safety and risk –Risk benefit analysis and reducing risk-Safety and the Engineer-Designing for the safety-Intellectual Property rights (IPR).

UINIT V: Global Issues

Globalization –Cross-culture issues-Environmental Ethics –Computer Ethics –Computers as the instrument of Unethical behaviour –Computers as the object of Unethical acts –Autonomous Computers-Computer codes of Ethics –Weapons Development -Ethics and Research –Analyzing Ethical Problems in research.

Course outcomes:

Students will be able to:

- Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field, Articulate what makes a particular course of action ethically defensible
- Identify the multiple ethical interests at stake in a real-world situation or practice, Assess their own ethical values and the social context of problems
- Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
- Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work
- Integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research.

Text Books:

1. “Engineering Ethics includes Human Values” by M.Govindarajan, S.Natarajan and, V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009
2. “Engineering Ethics” by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.
3. “Ethics in Engineering” by Mike W. Martin and Roland Schinzinger –Tata McGraw-Hill–2003.
4. “Professional Ethics and Morals” by Prof.A.R.Aryasri, DharanikotaSuyodhana-Maruthi Publications.
5. “Professional Ethics and Human Values” by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran-LaxmiPublications.
6. “Professional Ethics and Human Values” by Prof.D.R.Kiran-
7. “Indian Culture, Values and Professional Ethics” by PSR Murthy-BS Publication

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B.Tech VII-Semester	MAGNETIC AND ELECTRONIC MATERIALS (PROFESSIONAL ELECTIVE – III)	L	P	C
		3	0	3

Course objectives:

1. *To understand the fundamentals of magnetism and to learn about the various magnetic materials*
2. *To study about the Theories of magnetism and domain theory of Ferromagnetism*
3. *To understand the concept of hysteresis loop and the difference between hard and soft magnetic materials*
4. *To learn about the fundamentals of semiconductors and classification of semiconductors*
5. *To learn about the various applications of magnetic materials*

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. Barkhausen 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 magneto-striction, GMR (Giant Magnetic Resonance)

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 semiconductor devices

UNIT-V

Applications of magnetic materials: soft and hard, high energy hard magnetic materials, magnetic storage, ferritecore memories, bubble memories, piezoelectric ceramics, polymers, chemical sensors, electrochemical sensors, shapememoryalloys

Course Outcomes:

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

1. *Understands the theory of Magnetic phenomenon and Magnetic materials*
2. *Understand various Magnetic theories such as Domain theory*
3. *Understand the concept of hystersis loop, soft & hard magnets*
4. *Understand about theory behind semi conductor devices*
5. *learn about Magnetic materials performances*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√				√							
CO2	√		√									
CO3	√	√			√							
CO4	√											
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities should be tested by class room assessment techniques). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. Electronic properties of materials, R EHummel
2. Ferromagnetic materials structure and properties, RAMacurie

Reference Books:

1. An introduction to materials science , HLMancini
2. Magnetic Materials fundamentals and devices, NicolsSpaldin

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B.Tech VII-Semester	NUCLEAR MATERIALS (PROFESSIONAL ELECTIVE – III)	L	P	C
		3	0	3

Course objectives:

1. To learn about the fundamentals of nuclear physics, Nuclear interaction and nuclear reactions

2. To learn about the various types of reactors and their construction and working principle

3. To understand about the various materials used in nuclear reactors and their production

4. To have the knowledge about Occurrence, general characteristics and the processing of nuclear materials

5. To understand the production of various nuclear fuel elements and nuclear power production in India

UNIT – I

Elementary Nuclear Physics and Chemistry; Structure of nucleus, radioactivity, binding energy; nuclear interaction; fission and fusion; nuclear reaction; energy release and chain reactions; neutron absorption cross-section; multiplication and criticality concepts and factors.

UNIT – II

Reactor components; Types of reactors; PWR, BWR, Graphite Moderator Reactor, Heavy water Reactor, Graphite moderator Reactor, Light Water moderator Reactor, Liquid metal coolant reactor. Mechanisms of moderation, radiation detection, radiation effects on fissile and non-fissile materials; radiation damage and radiation growth; thermal cycling; protection against radiations.

UNIT – III

Materials for nuclear reactors; Considerations in selection and properties of common materials used as fuels, their physical and chemical properties; canning materials; coolants; control rods; reflectors and shielding materials. Production of reactor materials.

UNIT – IV

Indian resources: Occurrence and general characteristics of nuclear minerals. Flow sheets of processing of nuclear minerals for the production of nuclear grade uranium, thorium, beryllium and zirconium with emphasis on basic scientific principles involved.

UNIT – V

Production and enriched uranium and fabrication of fuel elements. Irradiated fuel processing for recovery of Plutonium. Nuclear power production in India and its economics and safety measures.

Course Outcomes:

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

1. Understand about nuclear Fission and fusion
2. Understand various reactor components and their applications
3. Analyize various materials that can be used as nuclear materials
4. have an idea on the sources of nuclear materials
5. Learn about production nuclear power generation

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√											
CO2	√				√							
CO3	√											
CO4	√				√							
CO5	√										√	

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

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Text Books:

1.Wright JC -Metallurgy in Nuclear Power Technology; Iliffe Book Ltd.,1962
2.Glasstone S and Snesonske A; Principles of Nuclear Reactor Engineering; Macmillan,London

Reference Books:

1.Wilkinson WD and MrphyWF Nuclear Reactor Metallurgy Van Nostrand1958
2.Symposium on Rare materials; Indian Institute of Metals.
3.Gurinsky DH and Dienes JL Nulcears Fuels,Macmillan.
4.Proceedings of the symposium on Nuclear Science and Engineering – Bhabha Atomic Research Centre, Bombay.

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B.Tech VII-Semester	NON FERROUS EXTRACTIVE METALLURGY (PROFESSIONAL ELECTIVE – III)	L	P	C
		3	0	3

Course objectives:

1. *Study of Extraction of copper from minerals to electro winning.*
2. *Study of Extraction of lead and Zinc.*
3. *Study of Extraction of Aluminum by different processes*
4. *Extraction of light metals like magnesium and titanium from various sources and methods*
5. *Purification of Uranium ore and production of reactor grade UO2 and U and study of simplified flow sheets of various metals and review of NF Industry in India.*

UNIT – I

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

UNIT – II

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

LEAD: Blast furnace smelting, Refining of lead bullion

UNIT – III

ALUMINIUM: Bayer process, Hall - Heroult process, Anode effect: Efficiency of the process, Refining, Alternative processes of 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, silver and gold. Review of non-ferrous metal industries in India.

Course Outcomes:

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

1.Understand Principles and practices of extraction of Cu
2.Understand Principles and practices of extraction of Zn and Pb
3.Understand Principles and practices of extraction of Al
4.Understand Principles and practices of extraction of Mg and Ti
5.Understand Principles and practices of extraction of Uranium, Extraction of Ni, Au and Ag metals

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2	√	√		√								
CO3	√	√										
CO4	√	√										
CO5	√	√					√					√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems.)

Text Books:

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

Reference Books:

1. Rare Metals Hand book - C.A. Hampel
2. Nuclear Reacto General Metallurgy - N. Sevryukov, B. Kuzmin and Y. helishchevr
3. Engineering - S. Glass Stone and A. Sesonske.
4. Nuclear Chemical Engineering - ManstionBendict and Thomas H. Pigfort

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B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech VII-Semester	CHEMICAL ANALYSIS OF METALS (PROFESSIONAL ELECTIVE-IV)	L	P	C
		3	0	3

Course objectives:

1. *To know the importance of various methods of Metallurgical analysis.*
2. *To know the various methods of qualitative analysis of ores and metals*
3. *To know the various methods of qualitative analysis of a few non-ferrous metals and alloys*
4. *To estimate various elements present in ferrous materials and various ores*
5. *To describe various instrumental methods of analysis and to compare the results with different wet methods*

UNIT – I

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

UNIT - II

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

UNIT-III

Qualitative analysis of common non-ferrous alloys such as brasses, bronzes and solders.

UNIT-IV

Estimation of C, S, Si, Mn and P in cast iron and steel.
Estimation of Cr, Ni, Mo, W and V in alloy steels.

UNIT-V

Instrumental analysis, Comparison with standard wet chemical methods, Spectroscopy, potentiometry, amperometric titration. Calorimetric titrations, polarography, conductometry, electro-analysis and flame photometry.

Course Outcomes:

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

1.Understand Principles and importance of chemical analysis
2.Understand about theory of indicatiors and solution methods
3 Learn Qualitative chemical analysis of non ferrous materials .
4.Estimate various components present in steels and alloy steels
5.Understand Principles of instrumental analysis

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4	√	√										
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested

periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. S.K.Jain-Metallurgical analysis.

Reference Books:

1. Iyer V.G., Metallurgical Analysis: BHU Press, Varanasi.
2. Agarwal, B.C. and Jain S.P., A Text Book of Metallurgical Analysis, Khanna Publishers, Delhi
4. Snell Foster D and Frank M Biffen: Commercial methods.of analysis / Che. Publishing

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech VII-Semester	ENERGY MATERIALS (PROFESSIONAL ELECTIVE-IV)	L	P	C
		3	0	3

Course objectives:

1. *To learn the solar cells phenomenon, different photovoltaic materials*
2. *To learn the concept the concept of fuel cell technology, materials usage of materials in batteries*
3. *To understand usage of materials in energy harvesting*
4. *To understand usage of materials in energy storage*
5. *To know about the different synthesis processes used for making energy materials*

UNIT – I

Solar cell materials: single and polycrystalline Silicon, amorphous silicon, CdSe, CdTe, Copper Indium Gallium Selenide (CIGS), Gallium Arsenide for applications in photovoltaic's , Quantum Dots

UNIT – II

Basics of electrochemical energy devices: mechanism and materials for different types of batteries, concept of fuel cell technology, super capacitors and hybrid fuel cells (PEM fuel cell, Acid/alkaline fuel cells.)

UNIT – III

Materials for energy harvesting: Piezoelectric, Pyroelectric and Thermo-electrics materials, Electrostatic (capacitive) Energy Harvesting materials, electro active polymers (EAPs), energy harvesting using Magnetic Induction.

UNIT – IV

Different types of energy storage and conversion devices: Solar energy conversion devices, Wind & Mechanical Energy storages, Sensible Heat Storage Materials. failure modes and environmental impact of energy materials

UNIT – V

Materials Synthesis Methods

Physical Methods: Vacuum Evaporation, Sputtering, Cathodic Arc Deposition, Chemical Vapour Deposition, Lithography

Chemical Methods: Sol-Gel technique, self assembly, colloidal method, hydro-thermal method, Co-precipitation method, solid state synthesis, micro-emulsion method.

Course Outcomes:

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

1.Understand how materials can be used for solar energy cretion
2.learn how chemical energy can be converted into electrical energy
3.Understand about theory of energy harvesting
4.Learn about differnt types of energy storage devices.
5.Learn about various synthesis methods for making energy materials

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√									
CO2	√	√	√									
CO3	√	√	√							√		
CO4	√	√	√							√		
CO5	√	√	√							√		

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested by conducting concept tests. Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Book:

1. Advanced Energy Materials, Ashutosh Tiwari & Sergiy Valyukh, J. Wiley & Sons
2. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, Oxford University Press.

Reference Books:

1. Materials Science in Energy Technology 1st Edition by G Libowitz.
2. Energy Storage & Conversion: Materials & Devices by A. Kumar, S. K. Das.

B. Tech (R20) UCEV (Autonomous) ***w.e.f*** **2020-21**

B.Tech VII-Semester	CERAMIC SCIENCE AND TECHNOLOGY (PROFESSIONAL ELECTIVE-IV)	L	P	C
		3	0	3

Course objectives:

1. *To Study structure and properties of ceramic materials*
2. *To understand phase transformation occuring in ceramic materials*
3. *To know about various processing techniques used for making ceramic materials*
4. *To Learn about various ceramic processing methods*
5. *To know the electrical, magnetic and optical properties of ceramic systems*

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

Powder Preparation Techniques: Sol-gel technology – Precipitation, Co-precipitation and Hydrothermal precipitation techniques. Preparation of Al2O3, ZrO2, SiC, Si3N4 BN & B4C.

UNIT – IV

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

UNIT – V

Microstructure, mechanical, Thermal, electrical, optical, magnetic, and chemical properties of ceramic materials

Course Outcomes:

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

1. *Know the structure and properties of different ceramic materials*
2. *Understand the phase diagrams and comprehend the phase transformations in ceramic materials*
3. *Understand the powder techiques for making ceramics*
4. *Learn about concept of sinteing and other ceramic producing methods .*
5. *Understand and design the electrical, magnetic and optical properties of ceramic systems*

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√		√							
CO2	√		√		√							
CO3	√		√		√		√					
CO4	√		√		√							
CO5	√		√		√		√					

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested by conducting concept tests. Emphasis should be given by conducting tutorial classes at the end of each unit.)

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

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech VII-Semester	SURFACE ENGINEERING AND TRIBOLOGY (PROFESSIONAL ELECTIVE – V)	L	P	C
		3	0	3

Course objectives:

1. *To explore different surface electrochemical reactions*
2. *To learn different electrochemical coating methods*
3. *To understand different physical coating methods*
4. *To understand different thermal spray coatings and various surface laser techniques*
5. *To understand various surface degradation phenomena*

UNIT – I

Chemical and electrochemical polishing, significance, specific examples, chemical conversion coatings, phosphating, chromating, chemical colouring, anodizing of aluminium alloys, thermochemical processes -industrial practices

UNIT – II

Surface pre-treatment, deposition of copper, zinc, nickel and chromium-principles and practices, alloy plating, electro composite plating, properties of electrodeposits, electroless, electroless composite plating; application areas, properties.

UNIT – III

Definitions and concepts, physical vapour deposition (PVD), evaporation, sputtering, ion plating, plasma nitriding, process capabilities, chemical vapour deposition (CVD), metal organic CVD, plasma assisted CVD.

UNIT – IV

Thermal spraying, techniques, advanced spraying techniques- plasma surfacing, detonation gun and high velocity oxy-fuel processes, laser surface alloying, laser cladding, specific industrial applications, tests for assessment of wear and corrosion

UNIT – V

Introduction to tribology, , types of wear, adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication

Course Outcomes:

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

1. Learn about the practice of chemical and electro polishings ,coatings and their industrial applications
2. Understand Electro deposition of metals and alloys of Cu, Zn, Ni, Cr, etc., with knowledge on prior surface pre-treatment
3. Understand Concepts behind PVD, CVD and their various types with suitable industrial illustrations.
4. Learn about Principles and practice of various thermal spray and LASER techniques
5. Understand Surface degradation through various types of wear and corrosion

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2	√	√										
CO3	√	√		√								√
CO4	√	√		√								√
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested by assessing group work. Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. 'Surface modification technologies - An Engineer's guide' SudarshanTS, Marcel Dekker, Newyork, 1989
2. VargheseC.D, 'Electroplating and Other Surface Treatments- A Practical Guide', TMH,1993
3.Surface engineering by D SRINIVASA RAO AND S.V.JOSHI

B. Tech (R20) UCEV (Autonomous) ***w.e.f*** **2020-21**

B.Tech VII-Semester	NANOMATERIALS (PROFESSIONAL ELECTIVE – V)	L	P	C
		3	0	3

Course objectives:

1. *To understand importance of nano materials and applications of various nano materials*
2. *To know about the different synthesis processes used for getting nano materials*
3. *To understand the mechanical behaviour of nano materials under various conditions*
4. *To know about the electrical and optical phenomena of nano materials*
5. *To know about the various characterization techniques used for seeing nano materials*

UNIT-I

General Introduction1-D ,2-D, 3-D nano structured materials, applications of Nano materials Synthesis of Nano materials-Top-down approach and Bottom-Up approach,

UNIT-II

Nanoparticle synthesis by Chemical Methods and Mechanical Methods

UNIT-III

Mechanical Behaviour, Anamolos Deformation behaviour of nanostructutred materials, Room temperature creep

UNIT-IV

Electrical Properties: Switching glasses with nanoparticles, Electronic conduction with nanoparticles

Optical Properties: Optical properties, special properties and the coloured glasses

UNIT-V

Structural characterization: Electron microscopy, scanning probe microscopy for nano science and technology, X-ray diffraction.

Course Outcomes:

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

1. Gain an overview of future technological advancements and increasing role of nanotechnology
2. understand synthesis route according to the requirements of the end product.
3. Understand mechanical behaviour of nano structured materials
4. Understand about electrical and optical properties of nano materils and their usage
5. Understand how to see nano particles using microscopy techniques

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√									√	√
CO2	√	√	√									
CO3	√	√	√	√								
CO4	√	√	√	√								
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested by giving take home assignments. Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books

1. Textbook of nanoscience and nanotechnology, B.S. Murty et al. Universities Press 2012
2. Nano: the essentials- T.Pradeep, Tata McGrawHill Publishers, 2007

Reference Books:

1. Introduction to nanotechnology, Charles P. Poole, Wiley publishers, 2003

B. Tech (R20) UCEV (Autonomous) *w.e.f* **2020-21**

B.Tech VII-Semester	SPECIAL PURPOSE STEELS (PROFESSIONAL ELECTIVE-V)	L	P	C
		3	0	3

Course objectives:

1. Understand principles of microalloying and problem associated with developing high strength steels
2. To know the properties, types and applications of stainless steels.
3. Selection of advanced and ultra-high strength steels for specific engineering applications.
4. To know the properties, types and applications of tool steels.
5. To know the properties, types and applications of Die steels.

UNIT-I

Definition of high strength steels, problems in developing high strength steels; discussion on fracture toughness; HSLA steels, principle of microalloying and thermomechanical processing; importance of fine grained steels

UNIT-II

Phase diagrams, composition, properties and applications of ferritic, austenitic, martensitic, duplex and precipitation hardenable stainless steels

UNIT-III

Dual phase steels, TRIP steels, TWIP steels, UHSS - maraging steels, metallurgical advantages, heat treatment, properties and applications

UNIT-IV

Tool steels; classification, composition, and application, constitution diagram of high-speed steels, special problems in heat treatment of tool steels

UNIT-V

Die steels; classification, composition, and application, special cutting steels, hadfield mangnese steels,

Course Outcomes:

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

1. Understand principles of microalloying and problem associated with developing high strength steels
2. Understand the properties, types and applications of stainless steels .
3. Understand the properties, types of special steels having specific engineering applications
4. Understand the properties, types and applications of tool steels and heat treatment procedure to obtain required properties
5. Understand the properties, types and applications of die steels and hadfield steels

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√									√	√
CO2	√	√	√									
CO3		√	√									
CO4	√	√		√								
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested by giving take home assignments. Emphasis should be given by conducting tutorial classes at the end of each unit.)

Books:

1. ASM Handbook, Vol 1. Properties and Selection: Irons, Steels, and High-Performance Alloys
2.Toolsteels-Wilson-Pergamon Press
3. Pickering P. B., 'Physical Metallurgy and the Design of Steels', Applied Science Publishers,

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech VII-Semester	TRANSPORT PHENOMENA (OPEN ELECTIVE-III)	L	P	C
		3	0	3

Course Objectives:

1. To understand basic concepts related to fluid flow in the context of metallurgical processes
2. To understand basic concepts related to heat transfer in the context of metallurgical processes
3. To become familiar with the equations related to heat transfer phenomena
4. To understand basic concepts related to mass transfer in the context of metallurgical processes
5. To become familiar with the mathematical treatment and equations related to transport phenomena

UNIT – I
Fluid Flow - Viscosity – differential mass and momentum balances –overall momentum balance – mechanical energy balance – applications
UNIT-II
Heat Transfer – heat conduction equation – applications – steady and transient heat conduction. Two dimensional heat conduction
UNIT-III
Convective heat transfer –concept of heat transfer coefficient – forced and free convection; Radiation – view factor - radiative heat exchange between surfaces
UNIT-IV
Mass Transfer - Diffusion: Diffusivity in gases, liquids, solids – convective mass transfer –concept of mass transfer coefficient
UNIT-V
Dimensionless analysis – Rayleigh's method, Buckingham method – use of differential equations – similarity criteria – applications in physical modeling

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

1. Understand Solve mass and energy balance calculations involved in fluid flow
2. Use the heat conduction equations in solving 1D and 2D heat transfer in real time situations
3. Differentiate the forced and free convection and perform calculations on convective and radiative heat transfer
4. Understand the concepts of diffusion, diffusivity in different materials and mass transfer coefficient
5. Model any processes by converting actual (descriptive) processes into appropriate equations and then attempt to solve the same

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√									
CO2	√	√	√									
CO3	√	√	√									
CO4	√	√										
CO5			√	√								√

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities should be tested periodically in classes. Unit tests are to be conducted at the end of each unit).

TEXT BOOKS

1. *A.K. Mohanty, "Rate Processes in Metallurgy", PH India Ltd., 2000*
2. *B.R.Bird, Stewart, Lightfoot, 'Transport Phenomena', John Wiley, NewYork, 1994*

REFERENCES

1. *Poirier D.R. and Geiger G.H., 'Transport Phenomena in Materials Processing', Springer International Publishers, Switzerland, 2016*

B. Tech (R20) UCEV (Autonomous) *w.e.f* **2020-21**

B.Tech VII-Semester	COMPOSITE MATERIALS (OPEN ELECTIVE-III)	L	P	C
		3	0	3

Course objectives:

1. *To know various types of composite materials and their applications*
2. *To Learn various types of fibers and their role as reinforcement in matrix material*
3. *To Learn different processing methods of composites.*
4. *To learn different processing methods based on their application.*
5. *To understand how composites behave under various stress conditions.*

UNIT-I

Introduction - Classification of composite materials based on structure, matrix and reinforcement. Advantages of composites - application of composites - functional requirements of reinforcement and matrix.

UNIT- II

Fibers: Preparation, properties and applications of glass fibers, carbon fibers, Kevlar fibers and metal fibers-properties and application of whiskers, particle reinforcements.

UNIT- III

Manufacturing of advanced composites: Polymer matrix composites: Preparation of Moulding compounds and – hand layup method – Autoclave method - Filament winding method - compression moulding – Reaction injection moulding.

UNIT- IV

Manufacturing of Metal Matrix Composites: Casting-Solid state diffusion technique. Cladding – Hot isostatic pressing. Manufacturing of Ceramic Matrix Composites: Liquid Metal infiltration-Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving

UNIT- V

Response of Composites to Stress: (a) Iso strain condition (b) Iso Stress condition (c) Load friction shared by the fibers

Course Outcomes:

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

1. Understand concept of reinforcement and its role in the composite
2. Use varuious fibers as reinforcement in the composite based on the application
3. know about vaarious manufactureing methods and their limitations
4. Understand fabrication metal matrix composite materials
5. understand how composites behave under vaarious stress conditions

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4	√	√										
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested

periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. Composite Materials-K.K.Chawla, Springer, 2nd Edition, 1998
2. An introduction to composite materials, D. Hull an T.W. Clyne, 2nd edition, Cambridge University press, 1996

Reference Books:

1. Composites ASM Hand Book, Vol. 21, 9th edition, 1989
2. Fundamentals of composites: Materials, manufacturing, methods an applications, Society of manufacturing engineers, 1989
3. Material Sciences and Technology – (R.. W. Cahn, P. Haasen, E, J, Kramer eds.) Vol 13
4. Structure and properties of composites (T. W. Chou ed.) VCH Winheim, 1993 – Composites by Cahn – VCH

B. Tech (R20) UCEV (Autonomous) ***w.e.f*** **2020-21**

B.Tech VII-Semester	COMPUTATIONAL MATERIALS SCIENCE (OPEN ELECTIVE-III)	L	P	C
		3	0	3

Course objectives:

1. basic concepts related to numerical methods
2. *To Learn various computer applications for steel making*
3. *To Learn burden caluculations.*
4. *To learn computer modelling of material behaviour .*
5. *To understand artifical intelligence.*

UNIT – I

Numerical methods for solution of ordinary differential equations. Application of regression analysis and curve fitting techniques.

UNIT-II

Computer applications for energy & material balance in B.F. and BOF Steel making processes

UNIT-III

Numerical solution of partial differential equations pertinent to heat, mass & momentum transfer. Computer applications in solidification, potential energy diagrams and experiments in metallurgy. Analysis of test data using softwares.

UNIT-IV

Use of computers for the construction of phase diagrams, alloys design and crystallography.

UNIT-V

Elements of modern artificial intelligence (AI) related techniques. Introduction to Genetic Algorithm and Artificial Neural Nets.

Course Outcomes:

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

1. Understand concept of numerical methds
2. Understand use of computers in B.F. and BOF Steel making processes
3. know about various numerical methods,their limitations and related equations
4. Understand use of computers related to various metallurgical processes
5. Become familiar with use of AI as a tool for wide range of metallurgical process

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4	√	√										
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

TEXT BOOKS

1.S. Yip (Ed.): Handbook of Materials Modelling, Springer, 2005.2.Santosh K. Gupta: Numerical Methods for Engineers, New Age International (P) Limited, New Delhi, 1998.

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech VII-Semester	SOLIDIFICATION PROCESSING (OPEN ELECTIVE-IV)	L	P	C
		3	0	3

Course objectives:

1. *To understand thermodynamic principles relevant to solidification*

2. *To understand thermodynamic principles relevant to nucleation and growth*

3. *To Understand the thermodynamics of solutions, principles of free energy minimization and quasi chemical theory*

4. *To analyze the binary, ternary and multi component phase diagrams to determine various thermodynamic parameters*

5. *To learn the importance of interface energy and shape on segregation*

UNIT-I

Introduction and important thermodynamic functions: Laws of thermodynamics-enthalpy, heat capacity, applications of first law to open and closed systems including chemical reactions; entropy, free energy and their interrelationships

UNIT-II

Thermodynamics of solidification; Nucleation and growth; Pure metal solidification, Alloy Solidification, Constitutional undercooling, Mullins-Sekerka instability; Single phase solidification: Cellular and Dendritic growth; Multiphase solidification: eutectic, peritectic and monotectic;

UNIT-III

Heterogeneous systems –equilibrium constants, Ellingham-Richardson diagrams, predominant area diagrams, principles of free energy minimization; energy balance of industrial systems; solutions-chemical potential, Raoult/Henry's law, Gibbs-Duhem equations, regular solutions, quasi chemical theory

UNIT-IV

Evolution of Phase diagrams -phase rule, free-energy-composition diagrams, solidus-liquidus lines, retrograde solidus; determination of activity and other thermodynamic parameters from phase diagrams; thermodynamic analysis of ternary and multi component systems, interaction parameters

UNIT- V

Principles and applications of molten slags and silicate melts; electrochemical methods and applications, aqueous systems; Interfaces-energy, shape, segregation at external and internal interfaces; solid electrolytes; Effect of high pressure on phase transformations.

Course Outcomes:

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

1. Understand thermodynamic principles of solidification

2. Attain knowledge on nucleation, growth, single phase and multi-phase solidification

3. know about various thermodynamic concepts related to heterogeneous systems

4. Understand how phase diagrams evolved

5. Understand important principles of interfaces

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2		√	√									
CO3	√	√										
CO4		√	√									
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1.Solidification Processing; Fleming, M.C., McGraw-Hill, N.Y., 1974

Reference Books:

1. Fundamentals of Solidification by Kurz, W. and Fisher, D.J., Trans-Tech Pub, Switzerland, 1989

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B.Tech VII-Semester	METALLURGICAL FAILURE ANALYSIS (OPEN ELECTIVE-IV)	L	P	C
		3	0	3

Course Objectives:

1. *To know the sources, types and microscopic features of different types of fracture*
2. *To understand the factors influence on the fatigue and creep failures and their remedial measures.*
3. *To know the role of various factors on the wear and corrosion failures*
4. *To Identify the causes for failures in castings, forgings and weldments*
5. *To understand how we can carry out failure analysis and life testing using mathematical methods*

UNIT – I

Stages of failure analysis, classification and identification of various types of fracture. Overview of fracture mechanics, characteristics of ductile and brittle fracture.

UNIT – II

General concepts, fracture characteristics revealed by microscopy, factors affecting fatigue life Creep, stress rupture, elevated temperature fatigue, metallurgical instabilities, environmental induced failure. Some case studies of failures.

UNIT – III

Analysis of wear failure. Corrosion failures- factors influencing corrosion and wear failures, Procedure for analyzing wear and corrosion failures, various types of hydrogen damage failures. Some case Studies

UNIT – IV

Causes of failure in forming, failure of iron and steel castings, improper heat treatment, stress concentration and service conditions. Failure of weldments - reasons for failure procedure for weld failure analysis. Some case Studies

UNIT – V

Reliability concept and hazard function, life prediction, condition monitoring, application of Poisson, exponential and Weibull distribution for reliability, mean time analysis between failures and life testing.

Course Outcomes:

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

1. Understand and Analyze the fracture phenomenon
2. Analyze the fracture phenomenon in various materials in high temperature failures
3. know about role of various factors on the wear and corrosion failures
4. various types of failures involved in manufactureing processes
5. Become familiar with important remedial measures

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4		√	√									
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's analytical abilities (with special focus on academically weak students) should be tested periodically in classes by giving problems). Emphasis should be given by conducting tutorial classes at the end of each unit.)

Text Books:

1. Colangelo V.J. and Heiser F.A., Analysis of Metallurgical Failure, 2nd 1987 edition, Wiley-Inter science
2. Metallurgical Failure Analysis Techniques and Case Studies by K P Balan, BS publication 2019 Edition

Reference Books:

1. Shipley R.J. and Becker W.T., Failure Analysis and Prevention, ASM handbook, Vol. 11, ASM International 2002
2. Powell G.W. and Mahmoud S.E., Failure Analysis and Prevention, Metals Handbook, Vol. 11, 9th 1986 edition, ASM International

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B.Tech VII-Semester	FERRO ALLOY TECHNOLOGY (OPEN ELECTIVE-IV)	L	P	C
		3	0	3

Course objectives:

1. *To obtain knowledge over the importance of ferro alloys and present status of ferro alloys in India*
2. *To obtain knowledge over the ferro alloy production and the physico chemical aspects involved*
3. *To study and learn about various furnaces used for production of ferro alloys*
4. *To study and learn about various production methods of ferro alloys*
5. *To study in detail about the production of ferro tungsten, ferro titanium and ferro vanadium*

UNIT-I

Introduction: Types of Ferro alloys and their uses: Present status of ferroalloy industry in India. Future plans and developments.

Lay out: Lay out of a ferro alloy plant and its production economics.

UNIT-II

Principles: Physicochemical aspects of ferroalloys. Production by various methods.

UNIT-III

Furnace types and its design, refractories, auxiliaries, power supply. Working voltage, power factor and efficiency.

UNIT-IV

Production: Production of ferro-silicon-calcium, ferromanganese (high and low carbon), Ferro-chrome(high and low carbon),Ferro-molybdenum.

UNIT-V

Ferro-tungsten, ferro-titanium, ferro-vanadium.

Course Outcomes:

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

1. Know different types of ferro alloys
2. Analyze physico chemical aspects involved in ferro alloy production
3. learn how to design furnaces for ferro alloy production
4. understand production of ferro manganese, ferro chrome and ferro molybdenum
5.understand production of ferro tungsten, ferro titanium and ferro vanadium

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√									√	√
CO2	√	√										
CO3	√	√										
CO4	√	√	√									
CO5	√	√										

(Assessment: The student should be evaluated based on the assignments and objective tests. The student's learning abilities (with special focus on academically weak students) should be tested periodically by asking to discuss some case studies))

Text Books:

1. A. Riss and Y. Khodorovsky , Production ferroalloys Mir Publishers,Moscow 1967.
2. B. P. Bharadwaj, The complete book on ferroalloys, NIIR Project consultancy services, 2014

Reference Books:

1. Hand book of Ferro alloys: theory and technology Edited by Michael Gasik, BH publishers, 2013

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B.Tech VII-Semester	INDUSTRIAL MANAGEMENT (Humanities and Social Science Elective)	L	P	C
		3	0	3

Course Objectives:

- To impart knowledge on scientific principles of management to improve productivity in manufacturing Industry.
- To impart knowledge on fundamentals of functional management to improve performance in industry.
- To introduce basic tools of operations management
- To teach concepts of personnel management and value engineering
- To provide fundamental principles of project management

Unit – I

Introduction: Definition of Industrial Engineering, Development, Applications, Role of an industrial engineer, Quantitative tools of IE and productivity measurement, Concepts of Management, Importance, Functions of management, Scientific management, Taylor's principles, Douglas McGregor's Theory X andTheory Y, Fayol's principles of management.

Unit-II:

Functional Management: Human Resource management: Concept and functions of Human Resource Management, Concept of HRM and HRD Industrial relations, Job-evaluation and merit rating, wage and salary administration.- Marketing Management: Marketing mix and elements of marketing, strategies.- Financial management: objective and functions of Financial Management.

Unit – III

Operations Management: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

Unit – IV

Plant location and layout: Types and principles of plant layouts, Factors affecting plant location and layout, -Statistical Quality Control: Types of control charts, control charts for variables and control charts for attributesand its applications with numerical examples.

Unit – V

Project management: Basics for construction of network diagram, Program Evaluation and Review Technique (PERT), Critical Path Method (CPM) – PERT Vs. CPM, determination of

floats, Project crashing and its procedure.

Course Outcomes:

Upon successful completion of this course you should be able to:

- The learner is able to analyses, interpret data and gain knowledge of Industrial Management.
- The knowledge of designing a system, component or process and synthesize solutions to achieve desired needs.
- The learner can use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for public health and safety, cultural, societal, and environmental constraints through work study.
- The learner can able to know about the application of statistics in quality control and management. The student can know their role as engineers in the present modern society and function effectively within multi-disciplinary teams.
- The learner can understand the fundamental concepts of effective project management design and conduct experiments.

Text Books:

1. Industrial Engineering and Management by O.P Khanna, Khanna Publishers
2. Industrial Engineering and Management by N.V.S. Raju, Cengage Learning

Reference Books:

1. Industrial Engineering and Production Management, Martand Telsang,S.Chand& Company Ltd. New Delhi
2. Operations Management by J.G Monks, Mc Graw Hill Publishers.
3. Production and Operations Management – R.Panneerselvam- PHI- 3rdEdition
4. Principles of Management by Koontz O' Donnel, McGraw Hill Publishers.
5. PERTandCPM by L.S Srinath, East west Press.
6. Production and operations management by K.C Arora.
7. Statistical Quality Control by Gupta.
8. Manufacturing Organization and Management, Harold T. Amrine, John

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B.Tech VII-Semester	HUMAN RESOURCES DEVELOPMENT (Humanities and Social Science Elective)	L	P	C
		3	0	3

Course Objectives:

- Today's competitive business environment owes its success to effective management of its human resource
- The students of human resources management must aware of basic aspects of human resource management
- To understand the functioning of human resource management in an organizational setting.
- This introductory course on Human Resource Management is designed for engineering students who wants
- The quality of the organization's employees, their attitude, behaviour and satisfaction with their jobs, and their behaviour towards ethics and values and a sense of fair treatment all impact the firm's productivity, level of customer service, reputation, and survival.

UNIT-I:

Concept of HRD-objectives-Structure-Need-Scope- HRD in selected industrial organisations- significance-HRD functions-Framework-Techniques-Attributes of a HRD manager.

UNIT – II:

HRD Strategies: - An Overview - Strategies - Training and Development - Methods - Evaluation of training programmes. HRD Process Model: Methods of Implantation, Evaluation of HRD programmes. Identification of HRD needs and Design and development of HRD programmes.

UNIT – III:

HRD interventions: Mentoring for employee development: Concepts of Mentoring-Perspectives- Mentoring relationship-Outcomes of Mentoring programmes-Design and implementation of formal-mentoring programmes-Barriers to mentoring-Role of mentoring in development, understanding the role and responsibilities of mentor, mentee-Special issues in Mentoring-Coaching role and responsibilities.

UNIT – IV:

Employee counselling for HRD: Overview of counselling programmes, employee assistance programme, stress management, employee wellness and health promotion. Career Planning, management, and development: Career development stages and activities, role of individual and organization in career planning, Issues in career management.

UNIT-V:

The future of HRD and HRD Ethics: Research, practice and education of HRD for innovation and talent development and management, Role of HRD in developing ethical attitude and behaviour and development, Ethical problems with HRD roles. Applications of HRD: HRD Climate, HRD for managing organizational change, HRD for Workers (blue collar employees), HRD Audit.

Course Objectives

- To have an understanding of the basic concepts, functions and processes of human resource management
- To be aware of the role, functions and functioning of human resource department of the organizations.
- To Design and formulate various HRM processes such as Recruitment, Selection, Training, Development, Performance appraisals and reward Systems, Compensation Plans and Ethical Behaviour.
- Develop ways in which human resources management might diagnose a business strategy and then facilitate the internal change necessary to accomplish the strategy
- Evaluate the developing role of human resources in the global arena.

Text Books:

1. Warner and Desimone, Human Resource and Development, Cengage India, 2016.
2. Aswathappa K. (2005) Human Resource and Personnel Management,4th Ed,Tata Mc Graw Hill Publishing Co. Ltd

References:

1. Arun Monappa; Personnel Management;
2. Rudrabasava Raj M.N. : Dynamic Personnel Administration Management of Human Resources;
3. Udai Pareek, Human Resource Development;
4. S. Ravishankar & R.K. Mishra (Ed). : Management of Human Resources in Public Enterprises;
5. Haribson F, Educational Planning and Human Resources Development, International Institute for Education, UNESCO, Paris;
6. Bell DJ, Planning Corporate' Manpower, Longman;
7. Walker James W'. Human Resource Planning, MGH.

B.Tech VII-Semester	STRATEGIC MANAGEMENT (Humanities and Social Science Elective)	L	P	C
		3	0	3

Course Objectives:

- The Strategic Management course is designed to explore an organization's vision, mission, examine principles, techniques and models of organizational and environmental analysis
- To discuss the theory and practice of strategy formulation and implementation such as corporate governance and business ethics
- To Identification, appreciation and interpretation of the critical challenges and opportunities before an organization.
- To develop a. A holistic approach to see business issues comprehensively and using other core and functional subject knowledge for decision-making.
- Conceptual, diagnostic and analytical and conceptual skills in strategy formulation And execution.

UNIT-I

Introduction: Concepts in Strategic Management, Strategic Management as a process – Developing a strategic vision, Mission, Objectives, Policies – Factors that shape a company's strategy – Crafting a strategy.

UNIT-II

Environmental Scanning: Industry and Competitive Analysis -Evaluating company resources and competitive capabilities – SWOT Analysis – Strategies and competitive advantages in diversified companies and its evaluation. Tools and techniques- Porter's Five Force Model, BCG Matrix, GE Model,

UNIT-III

Strategy Formulation : Strategy Framework For Analyzing Competition, Porter's Value Chain Analysis, Competitive Advantage of a Firm, Exit and Entry Barriers - Formulation of strategy at corporate, business and functional levels. Types of Strategies

UNIT-IV

Strategy Implementation : Strategy and Structure, Strategy and Leadership, Strategy and culture connection - Operationalising and institutionalizing strategy- Organizational Values and Their Impact on Strategy – Resource Allocation – Planning systems for implementation.

UNIT-V

Strategy Evaluation and control – Establishing strategic controls - Measuring performance – appropriate measures- Role of the strategist – using qualitative and quantitative benchmarking to evaluate performance - strategic information systems – problems in measuring performance – Strategic surveillance -strategic audit

Course outcomes:

- Students will be able to describe major theories, background work, concepts and research output in the field of strategic management.
- Students will demonstrate a clear understanding of the concepts, tools & techniques used by executives in developing and executing strategies and will appreciate its integrative and interdisciplinary nature.
- Students will be able to demonstrate effective application of concepts, tools & techniques to practical situations for diagnosing and solving organisational problems.
- Students will be able to demonstrate capability of making their own decisions in dynamic business landscape.
- Students will be able to develop their capacity to think and execute strategically.

Text Books:

1. Fred R. David, Strategic Management, Prentice Hall, New Delhi.

2. John.A.Pearce, Richard.B.Robinson, Jr.Amita.Mital TMH Publications latest edition .

3. Azaar Kazmi, Strategic Management, TATA MC HILL, latest edition

References

1. P.Subba Rao: Business Policy and Strategic Management, Himalaya Publishing House, New Delhi, 2010
2. Kazmi and Kazmi: Strategic Management and Business Policy, Tata McGraw Hill, 2009
3. R.Srinivasn: Strategic Management, PHI Learning, New Delhi, 2009
4. Adrian Haberberg & Alison: Strategic Management, Oxford University Press, New Delhi, 2009

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B.Tech VII-Semester	INNOVATION AND ENTREPRENEURSHIP (Humanities and Social Science Elective)	L	P	C
		3	0	3

Course Objectives:

- Entrepreneurship and Innovation subject combines theoretical and empirical perspectives with the development of practical skills and opportunities for the application of knowledge to real-life organizational issues faced by those establishing and managing innovation-driven organizations.
- Key concepts underpinning entrepreneurship and its application in the recognition and exploitation of product/ service/ process opportunities
- Key concepts underpinning innovation and the issues associated with developing and sustaining innovation within organizations
- How to design creative strategies for pursuing, exploiting and further developing new opportunities
- Issues associated with securing and managing financial resources in new and established organizations

UNIT I

Entrepreneurship: Definition of Entrepreneur, Entrepreneurial motivation and barriers; Internal and external factors; Types of entrepreneurs; Theories of entrepreneurship; Classification of entrepreneurship. Creativity and Innovation: Creative Problems Solving, Creative Thinking, Lateral Thinking, Views of De Bono, Khandwalaand others, Creative Performance in terms of motivation and skills.

UNIT II

Creativity and Entrepreneurial Plan: Idea Generation, Screening and Project Identification, Creative Performance, Feasibility Analysis: Economic, Marketing, Financial and Technical; Project Planning, Evaluation, Monitoring and Control, segmentation, Targeting and positioning of Product, Role of SIDBI in Project Management.

UNIT III

Operation problems: Incubation and Take-off, Problems encountered Structural, Financial and Managerial Problems, Types of Uncertainty. Institutional support for new ventures: Supporting organizations; Incentives and facilities; Financial Institutions and Small-scale Industries, Govt. Policies for SSIs.

UNIT IV

Family and non-family entrepreneurs: Role of Professionals, Professionalism vs. family entrepreneurs, Role of Woman entrepreneur, Sick industries, Reasons for Sickness, Remedies for Sickness, Role of BIFR in revival, Bank Syndications.

Unit V

Introduction to Innovation management, Managing Innovation within Firms, Business strategy & organization Knowledge, New Product Strategy & Managing New Product Development, Role of Technology in Management of innovation, managing for Intellectual Property Right.

Course outcomes:

- Have the ability to discern distinct entrepreneurial traits
- Know the parameters to assess opportunities and constraints for new business ideas
- Understand the systematic process to select and screen a business idea
- design strategies for successful implementation of ideas
- write a business plan

Text Books:

- Innovation and Entrepreneurship by Peter.F.Drucker, latest edition by Harper publications
- Management And Entrepreneurship (Vtu) 1St Edition 2013 by Ramamurthy, P ,Hudgikar K Reddy Sanjeev, New Age International (P) Ltd Publishers

References:

1) Couger, C-Creativity and Innovation (IPP, 1999)
2) Nina Jacob, -Creativity in Organisations (Wheeler, 1998)
3) Jonne&Ceserani-Innovation & Creativity(Crest) 2001.
4) BridgeSetal-Understanding Enterprise: Entrepreneurship and Small Business (Palgrave,2003)
5) Holt-Entrepreneurship: New Venture Creation (Prentice-Hall) 1998.
6) Singh P&Bhanderkar A-Winning the Corporate Olympiad:TheRenaissan cearadigm(Vikas)
7) Dollinger M J-Entrepreneurship (Prentice-Hall, 1999).
8) Tushman, M.L. & Lawrence, P.R. (1997)-Managing Strategic Innovation & Change Oxford .
9) Jones T. (2003)-Innovating at the Edge: How Organizations Evolve and Embed Innovation Capability.Butterwork Heinemann, U. K.
10) Amidon, D. M.(1997)-Innovation Strategy for the Knowledge Economy:The Kanawakening. Butterwork-Heinemann, New Delhi, India.

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B.Tech VII-Semester	Finite Element Analysis Tools **(Skill advanced course)**	**L**	**P**	**C**
		1	2	2

UNIT – I

Meaning of Finite Element Analysis,Introduction to nodes and elements,
Need for meshing and different types of meshing,different softwares using FEM

UNIT – II

Getting to know the basics of ANSYS ,Overview of different analysis systems available in ANSYS Workbench,Overview of different component systems in ANSYS

UNIT – III

Introduction to engineering data,Going through various material libraries provided by ANSYS,Understanding where and when to use particular materials,Creation of new material,Adding a material for analysis

UNIT - IV

Concept of Modeling, Study of stress analysis using ANSYS - Stress analysis of a rectangular plate with a circular hole, axisymmetric problems.Study of Dynamic Analysis using ANSYS

UNIT – V

Study of Thermal Analysis using ANSYS: 2D problems with conduction and convection boundary conditions
Study of Fluid flow Analysis using ANSYS: Potential distribution in the 2D bodies

REFERENCE BOOKS:

1.ANSYS Workbench Tutorial Release 14, Structural and Thermal Analysis Using Ansys Mechanical APDL Release 14 Environment, Kent Lawrence, Schroff Development Corporation,
2.Practical Finite Element Analysis,Nitin S. Gokhale, Sanjay S. Despande, Dr. Anand N. Thite, Finite To Infinite, ISBN 978-81-906195-0-9
3. FINITE ELEMENT ANALYSIS USING ANSYS®, SrinivasPaleti, Sambana, Krishna Chaitanya, Datti, Rajesh Kumar, PHI Publication, ISBN: 978-81-203-4108-1

WEB REFERENCE:

1. www.ansys.com
2.www.mece.ualberta.ca/tutorials/ansys
3. http://mae.uta.edu/~lawrence/
4. http://expertfea.com/tutorials.html

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B.Tech VIII-Semester	**Major Project**	**L**	**P**	**C**
		0	0	12

SYLLABUS FOR HONORS SUBJECTS

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech HONORS	ADVANCED MANUFACTURING TECHNOLOGY	L	T	P	C
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:

1. To analyze machining theory and material fabrication processes.
2. To learn advanced machining processes.
3. Getting knowledge about new casting processes.
4. To learn about new forming processes.
5. To know the modern welding technologies and advanced foundry processes.

UNIT - I
Advanced machining theory & practices - mechanisms of chip formation, shear angle relations, and theoretical determination of cutting forces in orthogonal cutting; analysis of turning, drilling, and milling operations; mechanics of grinding; dynamometry; thermal aspects of machining; tool wear; economics of machining; processing of polymers, ceramics, and composites.

UNIT- II
Advanced machining processes – Process principles, Material removal mechanism, Parametric analysis and applications of processes such as ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM), Electrochemical machining (ECM), Electro discharge machining (EDM), Electron beam machining (EBM), Laser beam machining (LBM) processes.

UNIT – III
Advanced Casting Processes: Metal mould casting, Continuous casting, Squeeze casting, vacuum mould casting, Evaporative pattern casting, ceramic shell casting.

UNIT – IV
Advanced Forming processes - electro-magnetic forming, explosive forming, electro-hydraulic forming, stretch forming, and contour roll forming.

UNIT – V
Advanced welding processes - EBW, LBW, USW; Advanced foundry processes - metal mould, continuous, squeeze, vacuum mould, evaporative pattern, and ceramic shell casting.

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

1. understand the cutting, turning and drilling processes and knowing the materials processing
2. understand the principles and mechanisms of advanced machining processes.
3. understand the various casting processes.
4. understand advanced forming processes.
5. understand advanced welding and foundry processes.

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√	√		√			√		√
CO2	√		√	√	√		√			√		√
CO3	√		√	√	√		√			√		√
CO4	√		√	√	√		√			√		√
CO5	√		√	√	√		√			√		√

Text Books:

1. Materials and Processes in Manufacturing, E.P. DeGarmo, J. T Black, R.A.Kohser
2. Manufacturing Science, A. Ghosh, and A.K. Mallik,
3. Nontraditional Manufacturing Processes, G.F.Benedict, Marcel Dekker

Reference Books:

1. ASM Hand book, Volume 15; Casting
2. ASM Hand book, Volume 6; Welding
3. ASM Hand book, Volume 16; Machining
4. ASM Hand book, Volume 14; Forming

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B.Tech HONORS	NANO COMPOSITES AND APPLICATIONS	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. To know the properties of nano materials.
2. To learn advanced nano composites
3. Getting knowledge of synthesis of nano composites .
4. To learn about new processing techniques used in making polymer composites.
5. To know nano harness techniques

UNIT – I

Introduction to Nanocomposites, Composite material, Mechanical properties of Nano composite material: stress - strain relationship, toughness, strength, plasticity.

UNIT-II

Ceramic based nanoporous composite, Metal matrix nanocomposites, Polymer-based nanocomposites Carbon nanotube based nanocomposites and Natural nano biocomposites.

UNIT-III

Synthesis methods for various nanocomposite materials: mechanical alloying, thermal spray synthesis etc.

Nano composites for hard coatings; DLC coatings; Thin film nanocomposites; Modeling of nanocomposites.

UNIT-IV

Processing of polymer nanocomposites, properties of nanocomposites, Salt infiltration, Powder mixing, Intrusion method, Exfoliation & interaction, Gel-casting impregnation techniques: Hot melt impregnation, solution impregnation.

UNIT –V

Nano Indentation, Types of indentation: Oliver & Pharr method, Vickers Indentation process, Berkovich indentation process, Brinell test, Knoop test

Course Outcomes:

After completing the course, the student shall be :

1. understand Nano materials prpoperties and how they are used as reinforcement in composites
2. understand various types nano composties with different matrix materials.
3. understand the concept of mechanical alloying and thickness of coatings
4. understand processing of various polymer composites.
5. Check and evaluate the hardness values of nano composites.

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√			√			√		√
CO2	√		√	√			√			√		√
CO3	√		√	√			√			√		√
CO4	√		√	√			√			√		√
CO5	√	√	√	√	√		√			√		√

Text Books:

1. Nanocomposite Science & Technology by P.M. Ajayan, L.S. Schadler and P.V. Braun, Wiley-VCH GmbH Co.
2. Thomas E. Twardowski, Introduction to Nanocomposite Materials, Properties, Processing, Characterization, DesTech Publications, April 2007

Reference Books:

1. Encyclopedia of Nanotechnology by H.S.Nalwa
2. Encyclopedia of Nano Technology by M.Balakrishna rao and K.Krishna Reddy, Vol I to X
3. Introduction to Nano Technology by Charles. P.Poole Jr and Frank J. Owens; Wiley India Pvt Ltd.
4. Nanotechnology, A gentle introduction to the next big idea by Mark Ratner, Daniel Ratner Pearson education.

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B.Tech HONORS	PLASTICITY AND PLASTIC DEFORMATION	L	T	P	C
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:

1. To introduce the concepts of plasticity
2. To expose different methods to analyze stress and strain in materials
3. To examine different types of stress and stain relations in plasticity.
4. To expose to dislocation mechanisms.
5. To get the knowledge in the field of severe plastic deformation

UNIT-I: Elements of theory of plasticity, Basics of plastic deformation, The flow curve. True stress and true strain – Mohr's circle: one dimension, two dimensions and three dimension- Von Mises distortion energy criterion, maximum shear stress or Tresca criterion.

UNIT-II: Basic equations of principal stress and strain, stress-strain relation, anisotropy, viscoplasticity, anisotropy.Physical overview of crystal plasticity, plasticity of granular media, plasticity in rubber-like materials.

UNIT-III: Hydrostatic and Deviatoric stress, Octahedral stress, texture and distortion of yield surface, Limitation of engineering strain at large deformation,strain hardening, Ramberg-Osgood equation, stress - strain relation in plasticity. Hall-Petch and other hardening mechanisms, grain size effect - source limited plasticity

UNIT-IV: Microscopic view of plastic deformation**:** classification of defects, geometry of dislocations, slip and glide, - Frank Read and grain boundary sources, stress and strain field around dislocations. Dislocation interactions, twinning, dislocation movement ,deformation behavior of single crystal, critical resolved shear stress (CRSS), deformation of poly-crystals

UNIT-V: Severe plastic deformation by ECAP, microstructural variation with different processing routes of ECAP – strain distribution and texturing.

Course Outcomes:
After completing the course, the student shall be :

1. explain plastic deformation with stress and strain criteria
2. explain equations involved with stress and strain
3. explain different types of stress-strain relation in plasticity
4. understand the mechanisms involved with plastic deformation with respect to dislocations

5. explain different processes of ECAP

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√		√			√		√
CO2	√	√	√	√	√		√			√		√
CO3	√	√	√	√	√		√			√		√
CO4	√	√	√	√	√		√			√		√
CO5	√	√	√	√	√		√			√		√

Text Books:

1. G.E. Dieter, "Mechanical Metallurgy", McGraw-Hill, 1986.
2. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", John Wiley and Sons, 1976.

References:

1. Hosford W.F. and Caddell R.M. “Metal forming mechanics and metallurgy”, Printice Hall 1983.

2. Aliofkhazraei (Ed), “Handbook of Mechanical nanostructuring” Contributed by .B.Ravisankar, Wiley-VCH Publishers, Germany, 2015

B.Tech HONORS	ADVANCED THERMODYNAMICS OF MATERIALS	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. To analyze laws of thermodynamics to energy systems
2. To explain the nucleation and growth process relavent to metallurgical thermodynamics
3. To analyze experimental procedures related to thermodynamics
4. To exposure to applications of thermodynamics to various systems and materials
5. To exposure to modeling techniques in thermodynamics

UNIT-I

Review of thermodynamics – metallurgical, mechanical and statistical perspectives

UNIT-II

Thermodynamics of solidification; Nucleation and growth; Pure metal solidification, Alloy Solidification, Constitutional undercooling, Single phase solidification: Cellular and Dendritic growth; Multiphase solidification: eutectic, peritectic and monotectic; Modelling of solidification

UNIT-III

Experimental procedures related to Thermodynamics – calorimetry, activity measurements, interaction co-efficient, and electrochemical cells ,Thermodynamics of Defects.

UNIT-IV

Application of thermodynamics to surfaces, interfaces, bulk metallic glasses, high-entropy systems and novel materials

UNIT-V

Modeling techniques used in thermodynamics of materials - In the context of phase diagrams, free energy calculations, electrochemical cells, corrosion, alloy development. introduction to thermodynamics of nano systems

Course Outcomes:

After completing the course, the student shall be :

1. explain laws of thermodynamics with metallurgical, mechanical and statistical perspectives.
2. explain metallurgical thermodynamics involved with homogeneous and heterogeneous nucleation processes.
3. explain thermodynamics with respect to experimental procedures.
4. explain thermodynamics in various applications
5. understand the modeling of thermodynamics of materials

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√			√					√
CO2	√	√	√	√			√					√
CO3	√	√	√	√			√					√
CO4	√	√	√	√			√					√
CO5	√	√	√	√	√		√					√

Text books:

1. Gaskell, David R., Introduction to Metallurgical Thermodynamics, McGraw Hill
2. Mohanty, A.K., Rate Processes in Metallurgy", Prentice Hall of India, 2000

References:

1. Darken and Gurry, Physical Chemistry of metals

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech HONORS	ADVANCED POWDER METALLURGY	L	T	P	C
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:

1. To understand advanced process of powder metallurgy
2. To understand the powder particulate processing
3. To understand the compaction processes
4. To understand the sintering process and reaction milling process
5. To understand application of powder metallurgy

UNIT I: SWOT analysis of powder metallurgy, advanced powder fabrication and sintering techniques

UNIT II: Science of particulate processing – issues related to particle morphology – differences in mechanical behaviour (with respect to cast and wrought materials) and related mathematical treatment - similarities and differences between metal powder and ceramic powder processing

UNIT III: Production and characterisation of metal and ceramic powders – compaction processes – powder properties and powder compaction – Pressing, Hot Isostatic Processing and extrusion

UNIT IV: Sintering – thermodynamic and process aspects – recent developments in mechanical alloying and reaction milling

UNIT V: Production of particulate composites - application of P/M based on case studies - manufacturing of typical products – near net shape processing

Course Outcomes:
After completing the course, the student shall be :

1. explain advanced powder metallurgy techniques
2. explain metal powder and ceramic powder particulate processing
3. understand compaction and extrusion processes
4. select appropriate method for sintering
5. explain applications of powder metallurgy based on case studies

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√			√			√		√
CO2	√		√	√			√			√		√
CO3	√		√	√			√			√		√
CO4	√		√	√			√			√		√
CO5	√		√	√			√			√		√

Text books:

1. German R.M., 'Powder Metallurgy Science', Metal Powder Industries Federation, New Jersey, 1994

2. A.K.Sinha, Powder Metallurgy

References:

1. Kuhn H. A. and Alan Lawley, 'Powder Metallurgy Processing - New Techniques and Analysis', Oxford IBH, Delhi, 1978.

2. P.C. Angelo, R.Subramanyam, Powder Metallurgy,

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		L	T	P	C
B.Tech HONORS	**THIN FILM SCIENCE AND TECHNOLOGY**	3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. To learn principles of vacuum technology
2. To learn about deposition and properties of thin films
3. To learn vapor deposition techniques.
4. To learn about various methods in thin film deposition.
5. To learn various deposition techniques.

UNIT – I:

Vacuum technology: Clean Room – Clean room technology and its Classes.

Principles of vacuum pumps in range of 10^{-2} torr to 10^{-11} torr, principle of different vacuum pumps: roots pump, rotary, oil diffusion pump, turbo molecular pump, cryogenic-pump, ion pump, Ti-sublimation pump, importance of measurement of vacuum, Concept of different gauges: Bayet-Albert gauge, Pirani, Penning and pressure control.

UNIT – II:

Conditions for the formation of thin films:

Environment for thin film deposition, deposition parameters and their effects on film growth, formation of thin films , capillarity theory, microstructure in thin films, adhesion.

properties of thin films: Mechanical, electrical, and optical properties of thin films,Thermomechanical behaviour of thin film nanostructures.

UNIT-III:

Physical Vapour Deposition techniques: Thermal evaporation, resistive evaporation, Electron beam evaporation, Laser ablation, Flash and Cathodic arc deposition.

UNIT –IV:

Electrical discharges used in thin film deposition: Sputtering, Glow discharge sputtering, Magnetron sputtering, Ion beam sputtering, R.F sputtering, Triode sputtering, Ion Plating, Difference between thin films and coating.

UNIT –V:

Electro deposition, molecular beam epitaxy and laser pyrolysis. Chemical vapour deposition techniques: Advantages and disadvantages of Chemical Vapour deposition (CVD) techniques over

PVD techniques, reaction types, Different kinds of CVD techniques: Metal Organic CVD (MOCVD), Thermally activated CVD, Spray pyrolysis

Course Outcomes:

After completing the course, the student shall be :

1. Able to explain principles involved with pumps and gauges
2. Able to explain requirements for the formation of thin films
3. Able to explain physical vapour deposition techques
4. Able to explain various sputtering techniques.
5. Able to understand the chemical deposition techniques.

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√			√					√
CO2	√		√	√			√					√
CO3	√		√	√			√					√
CO4	√		√	√			√					√
CO5	√		√	√			√					√

Text Books

1. Thin Film Phenomenon by K.L. Chopra, McGraw-Hill

References

1. Methods of Experimental Physics (Vol 14) by G.L.Weissler and R.W.Carlson “Vacuum Physics and Technology”
2. A User’s Guide to vacuum Technology by J.F.O’Hanlon, John Wiley and Sons
3. Vacuum Physics and Techniques by T.A. Delchar, Chapman and HallEvaporation: Nucleation and Growth Kinetics” by J.P. Hirth and G.M.Pound, Pergamon Press

B. Tech (R20) UCEV (Autonomous) *w.e.f* 2020-21

B.Tech HONORS	STATISTICAL QUALITY CONTROL	L	T	P	C
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:

1. To know various processes involved with quality
2. To know about quality management system
3. To know about calculation procedures involved with statistics and probability
4. To learn about statistical quality processes
5. To know about sampling procedure for quality

UNIT I: Quality – philosophy; cost of quality; overview of the works of Juran, Deming, Crosby, Taguchi; quality loss function; quality control; quality assurance; quality audit; vendor quality assurance.

UNIT II: Quality organization; quality management system; total quality management; quality awards; quality certification; typical procedure for ISO 9000, ISO 14000, QS 9000.

UNIT III: Review of calculation procedures involving statistics and probability; exposure to some applications of statistics and probability; distribution functions; normal distribution curve.

UNIT IV: analysis of variance – statistical tools – statistical quality control; control charts; process capability analysis; statistical process control; introduction to six sigma

UNIT V: inspection by sampling; acceptance sampling; statistical approaches; single, double and multiple sampling plans; statistical design of experiments.

Course Outcomes:
After completing the course, the student shall be :

1. understand the concept of quality
2. understand requirements for quality standards
3. understand calculation procedures involved with statistics
4. analyze various tools
5. understand the procedure for sampling to get quality

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√						√		√
CO2	√		√	√						√		√
CO3	√		√	√						√		√
CO4	√		√	√						√		√
CO5	√		√	√						√		√

Text Books:

1. Hansen B.L., P.M. Ghare, 'Quality Control and Application', PHI – EEE, 1997.
2. Juran J.M., and F.M.Gryna, 'Quality Planning and Analysis', McGraw Hill, New York, 2nd Edition, 1980

B.Tech HONORS	ADVANCED CERAMICS FOR STRATEGIC APPLICATIONS	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. To learn about oxide and non-oxide ceramic materials
2. To learn about different methods of ceramic materials shaping
3. To learn about ceramic powders sintering
4. To learin about ceramic materials in engineering applications
5. To learn about carious types of composite materials

Unit I:

Introduction: oxide and non-oxide ceramics, their chemical formulae, crystal and defect structures, non-stoichiometry and typical properties.
Powder Preparation: Physical methods (different techniques of grinding)
Chemical routes – co-precipitation, sol-gel, hydrothermal, combustionsynthesis, high temperature reaction (solid state reaction).

Unit II:

Basic principles and techniques of consolidation andshaping of ceramics: powder pressing- uniaxial, biaxialand cold isostatic and hot isostatic, injection moulding,slip casting, tape-casting, calendaring, multilayering.

Unit III:

Sintering: different mechanisms and development ofmicrostructure (including microwave sintering)
Preparation of single crystal, thick and thin filmceramics and their Mechanical behavior

Unit IV:

Engineering applications: At room and hightemperatures , Transparent ceramics, coatings and films: preparation and applications
Ceramics for energy and environment technologies(fuel cell, lithium battery, gas sensor and catalytic support)

Unit V:

Ceramics matrix composites: different types, theirpreparation and properties
Exotic ceramics: functionally graded, smart/ Intelligent,bio-mimetic

nano- ceramics - basic principles, preparation and applications

Course Outcomes:
After completing the course, the student shall be :

1. understand oxide and non-oxide ceramics
2. understand the processes involved in shaping of ceramic materials
3. understand the mechanism of sintering in ceramic powders
4. understand the applications of ceramic materials
5. understand ceramic matrix composites, exotic ceramics and nano-ceramics

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√			√			√		√
CO2	√		√	√			√			√		√
CO3	√		√	√			√			√		√
CO4	√		√	√			√			√		√
CO5	√		√	√			√			√		√

Text Books:
1.Handbook of Advanced Ceramics: Materials, Applications, Processing, and Properties
By Academic Press

2.Handbook of Advanced Ceramics and Composites: Defense, Security, Aerospace and Energy Applications Hardcover – Import, 8 October 2020

B.Tech HONORS	CARBON NANOTECHNOLOGY	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. To introduce The Geometry of Nanoscale Carbon
2. To expose different types of fullerene materials
3. To know the structure of Carbon nano tubes.
4. To learn about graphene sheet and its properties
5. To get the knowledge various applications of Nano materials

UNIT-I

Introduction –Carbon molecules-nature of the carbon bond-new carbon structures-discovery of C60-structure of C60 and its crystal From a Graphene Sheet to a Nanotube

UNIT-II

FULLERENES: Structure and Bonding- Nomenclature, The Structure of C60, Structure of Higher Fullerenes - Growth Mechanisms; Production and Purification- Fullerene Preparation by Pyrolysis of Hydrocarbons, Partial Combustion of Hydrocarbons, Arc Discharge Methods.

UNIT-III

CARBON NANOTUBES: The Structure of Carbon Nanotubes- Nomenclature, Structure of Single-Walled Carbon Nanotubes and Structure of Multiwalled Carbon Nanotubes; - Raman and Infrared Spectroscopy of Carbon Nanotubes, Absorption and Emission Spectroscopy of Carbon Nanotubes.

UNIT-IV

GRAPHENE: Structure of graphene; Preparation of graphene – synthesis of graphene by various physical and chemical methods and Purification; Electronic Properties - Band Structure of Graphene - Mobility and Density of Carriers - Quantum Hall Effect.

UNIT-V

APPLICATIONS OF CARBON NANOMATERIALS: Application of Fullerene, CNT, Graphene and other carbon nanomaterials - Mechanical, Thermal Applications, Electronic Applications and biological Applications.

Course Outcomes:
After completing the course, the student shall be :

1. understand carbon nano technology
2. understand various types of fullerenes and related mechanisms
3. know structure and properties of CNTs
4. know structure and properties of Graphene
5. Learn various application carbon nano materials

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√			√					√
CO2	√		√	√			√					√
CO3	√		√	√			√					√
CO4	√		√	√			√					√
CO5	√		√	√			√					√

TEXT BOOKS

1. Anke Krueger, “Carbon Materials and Nanotechnology”, Wiley-VCH , 2010.
2. Yury Gogotsi, “Carbon Nanomaterials”, Taylor and Francis, 2006.

B.Tech HONORS	MATERIALS AND ENERGY BALANCE IN METALLURGICAL PROCESSES	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. To learn about energy balance and energy conservation
2. To learn about stachometry
3. To learn about principles of materials and energy balance
4. To learn about principles of processing
5. To learn about energy balances in various processes

UNIT I:

Introduction, Relationship between energy balance, energy conservation and environment. Dimensions, units and conversion factors.

UNIT II:

Stoichiometry; Principles of calculations. Sampling and measurements.

UNIT III:

Principles of materials and energy balance; Laws of thermodynamics, Thermochemistry and illustration of the concept swith suitable examples.

UNIT IV:

Fundamental Principles of metal extraction and refining and combustion, carbonization and gasification.
case studies: material balance in mineral processing unit operations.

UNIT V:

Set up and illustration of energy balances in various unit processes like calcinations, sintering, roasting, smelting, converting, refining, gasification, carbonization etc.
Case studies: Energy balance of a reheatingfurnace, rotary kiln ,etc.

Course Outcomes:

After completing the course, the student shall be :

1. Understanding the concept of energy balance and energy conservation
2. understand the principles of calculations
3. understand principles of energy balance
4. understand fundamental principles with a case study
5. understand energy balance in various processes

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√			√			√		√
CO2	√	√	√	√			√			√		√
CO3	√	√	√	√			√			√		√
CO4	√	√	√	√			√			√		√
CO5	√	√	√	√			√			√		√

Text Books:

1. R.Schuhman n Jr. Metallurgical engineering, vol.1: Engineering principles.
2. O.P.Gupta: Elements of fuels,furaces and refractory.
3. Handbook on Material and Energy Balance Calculations in Metallurgical Processes, Hardcover, Fine H. Alan

		L	T	P	C
B.Tech HONORS	**FINITE ELEMENT TECHNIQUES IN MATERIALS PROCESSING**	3	1	0	4

Course Objectives:
The students will acquire the knowledge:

1.To learn about steps involved in FEM modeling
2. To learn about types and interpolation functions
3,To learn about modeling in FEM
4.To learn about analysis using deform software
5.To learn using of SYSweld for analysis

UNIT I: FEM modelling - general steps; different approaches for deriving element properties: direct approach, variational approach, and Galerkin's method;

UNIT II: Types of elements and interpolation functions; condensation and substructuring; continuity requirements; mesh refining; Gauss quadrature;

UNIT III: FE modelling for structural and thermal problems

UNIT IV: Analysis of deformation processes and microstructures using Deform software

UNIT V: Analysis of solidification for both casting and welding using SYSweld

Course Outcomes:
After completing the course, the student shall be :

1. understand FEM modeling
2. understand various elements of modeling

3. analyze structural and thermal problems using FEM modeling
4. analyze deformation processes and microstructures using Deform software
5. analyze casting and welding using SYSweld

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√		√					√
CO2	√	√	√	√	√		√					√
CO3	√	√	√	√	√		√					√
CO4	√	√	√	√	√		√					√
CO5	√	√	√	√	√		√					√

Text books:

1.The Finite Element Method: Its Basis and Fundamentals, C. Zienkiewicz, R. L. Taylor, J.Z. Zhu; 6th Edition, 2005.

2.Concepts and applications of finite element analysis, Robert Davis Cook.

References:

1. Material Science for Engineers – Vanvlack

B.Tech HONORS	NANO MATERIAL SYNTHESIS	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. To learn about various approachs of nano materials synthesis
2. To learn about different chemical methods used for nano synthesis
3. To learn about advanced nano synthesis techniques
4. To learin about how nano material grain orientation change on SPD techniques
5. To learn about biological methods used for nano synthesis

Unit-I

Introduction to synthesis of nanostructure materials, Bottom-up approach and Top-down approach with examples, Stabilization techniques – Electrostatic and Steric stabilizations. **Physical methods:** Inert gas condensation, Arc discharge, RF-plasma, plasma arc technique, electric explosion of wires, ball milling,

Unit II:

Chemical methods**:** Chemical Kinetics, Gibbs Free Energy- Thermodynamics. Thermolysis route - spray pyrolysis and solvated metal atom dispersion, sol-gel method, solvothermal and hydrothermal routes, solution combustion synthesis, Chemical vapor synthesis.

Unit-III:

Advanced Chemical Techniques**:** Nanocrystals by chemical reduction, photochemical synthesis, electrochemical synthesis; Nanocrystals of semiconductors and other materials by arrested precipitation, emulsion synthesis, and sonochemical routes.

Unit IV:

Nano Synthesis By Seviour Plastic Deformation(SPD): Effect of Grain Architecture On The Ductility In Ultrafine Grained And Nanocrystalline SPD Materials. SPD techinques,Advantages and limitations of SPD nanosynthesis over other Techniques.

Unit-V

Biological methods**:** Use of bacteria, fungi, actinomycetes for nano-particle synthesis – magneto-tactic bacteria for natural synthesis of magnetic nano-particle.

Course Outcomes:
After completing the course, the student shall be :

1.Choose a tailor made synthesis route according to the requirements of the end product
2.Learn chemical synthesis route to get nano materials
3.future advancements in synthesis of nano materials
4.Effect of grain structure on SPD
5.Learn Biological synthesis of nano materials

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√			√			√		√
CO2	√		√	√			√			√		√
CO3	√		√	√			√			√		√
CO4	√		√	√			√			√		√
CO5	√		√	√			√			√		√

Textbooks:

1. Inorganic Materials Synthesis and Fabrication by J.N. Lalena, D.A. Cleary, E.E. Carpenter, N.F. Dean, John Wiley & Sons Inc.
2. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.
3. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R.
Rao, A. Muller and A.K. Cheetham

Reference books:

1. Encyclopedia of Nanotechnology by M.Balakrishna Rao and K.Krishna Reddy, Vol I to X, Campus books.
2. Encyclopedia of Nanotechnology by H.S. Nalwa
3. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology – by T.Pradeep; Tata Mc.Graw Hill

B.Tech HONORS	ADDITIVE MANUFACTURING	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1.To learn about Additive Manufacturing advantages
2.To learn about Additive manufacturing process
3. To learn about principles of Additive Manufacturing
4. To learn various Additive Manufacturing technologies
5. To know application of Additive Manufacturing in various industries

UNIT I: **Introduction to Additive Manufacturing:**

AM evolution, Distinction between AM & CNC machining, advantages of AM.

UNIT II : AM process chain:

Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, machine setup, build , removal and clean up, post processing

Classification of AM processes:

Liquid polymer system, discrete particle system, molten material systems, and solid sheet system.

UNIT III: Design for AM:

Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of supports, hollowing out parts, Inclusion of undercuts and other manufacturing constraining features, interlocking features.

UNIT IV:AM Technologies:

Powder-based AM processes involving sintering and melting (selective laser sintering, shaping, electron beam melting. involvement). Stereolithography, Laminated object manufacturing.

UNIT V: Application examples for aerospace, defense, automobile, Bio-medical and general engineering industries

Course Outcomes:

After completing the course, the student shall be :

1. Understanding Additive Manufacturing evaluation
2. CAD use in Additive Manufacturing
3. know the design requirements for Additive Manufacturing
4. Understanding powder based electron beam melting in Additive manufacture technology
5. Understanding Additive Manufacturing technologies in various industries

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√						√		√
CO2	√	√	√	√	√					√		√
CO3	√	√	√	√						√		√
CO4	√	√	√	√						√		√
CO5	√	√	√	√						√		√

Text books:

1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.

2. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010

References:

1.Ali K. Kamrani, EmandAbouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006.

2.D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001

		L	T	P	C
B.Tech HONORS	**ADVANCES IN IRON AND STEEL MAKING**	3	1	0	4

Course Objectives:
The students will acquire the knowledge:

1.To learn about the raw materials required and processing
2.To learn about various processes of iron making
3.To learn various processes of steel making
4.To learn about advanced steel making proesses
5. To understand the solidification of steel and its modeling

UNIT I: Processing of raw materials: Coke making, processing of lime and dolomite stone. Iron ore processing and agglomeration techniques

UNIT II: Iron making: Modern trends in Blast Furnace Operation, alternative routes of Iron Production (COREX, MBF), direct reduction process: HYL, SL/RN processes, Midrex, fluidized bed.

UNIT III: Steel making: Electric furnace steel making, Hybrid steel making processes, Tandem, SIP, OBM, high tension electric steel making, plasma arc steel making processes.

UNIT IV: Advanced techniques in steel making: WORCRA, IRSID, Spray steel making, INRED, ELRED processes. Production of High purity steel: Non-metallic inclusions and their effect on properties of steel. Refining techniques, ESR, VAR, and Vacuum Degassing of liquid steel. Alloy steel making, Tool steels and stainless steel making practice.

UNIT V: Solidification and casting operations: Principles of solidification of steel, ingot casting, continuous casting, modelling of steel making process.

Course Outcomes:

After completing the course, the student shall be :

1. know the raw materials processing and sintering technique
2. Understanding the iron making processes
3. Understand the steel making processes
4. Understanding developments in steel making processes
5. Understanding solidification of steel casting processes

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√			√					√
CO2	√		√	√			√					√
CO3	√		√	√			√		S			√
CO4	√		√	√			√					√
CO5	√		√	√	√		√					√

Text books:

1. Reduction of Iron Ores – VAN BOGDANDY.
2. Aspects of Modern ferrous Metallurgy – J.S.KIRKALDY & G.WARD.

References:

1.IIM-Silver Jubilee Symposium on Recent Developments in Materials Science and Technology.
2. Making, Shaping Treating of Steel published by United States Steel Corporation.
3. Introduction of Modern Iron Making – R.H.TUPKARY.
4. Introduction of Steel making – R.H.TUPKARY
5. Iron making and steel making-Ahindra Ghosh and Amit chatterjee, PHI Learning Pvt Ltd.

B.Tech HONORS	SUPERALLOYS	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1.To know about superalloys

2.To learn about physical metallurgy of supereralloys

3.To learn about microstructure/defect - property relationships in superalloys

4. To learn about processing of superallous

5. To learn about casting methods of superalloys

UNIT –I

Introduction to superalloys, Guide to selection of super alloys, Wrought superalloys, Heat Resistant castings.

UNIT –II

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 –III

Relationship of properties to Microstructure in superalloys. Fracture properties of superalloys. High temperature corrosion and use of coatings for protection.

UNIT –IV

wrought superalloys. Process and Metallurgical factors affecting on superalloys and other high temperature materials.

Melting of Superalloys: Principles and practices of vacuum Induction Melting and Vacuum Arc melting.

UNIT- V

Casting methods - Improving turbine blade performance by solidification control-The development of single crystal turbine blades. Forming and Fabrication of superalloys: Recent developments in P/M of superalloys-Production of components by Hot-Isostatic Pressing.

Course Outcomes:

After completing the course, the student shall be :

1. understand various types of superalloys
2. understand physical metallurgy of superalloys
3. understand corrosion and fracture properties of superalloys
4. knowing the processing of superalloys
5. Understanding the various methods of superalloys production

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√			√					√
CO2	√		√	√			√					√
CO3	√		√	√			√					√
CO4	√		√	√			√					√
CO5	√		√	√			√					√

TEXT BOOKS

1. Super alloys: Source book: Mathew J. Donachie. Jr. editor : 1984.
2. The super alloys: edited by Chester T. Sins and William C Haagel: 1972.

REFERENCE

1. Campbell IE High temperature MATERIALS, John wiley and sons Inc.;1956

B.Tech HONORS	AEROSPACE MATERIALS	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1.To learn about aerospace materials and properties

2.To learn about testing of aerospace materials

3.To learn about materials required for Gas Turbines and Rocket combustion chambers

4. To know ferrous and non ferrous materials for aircraft construction

5. To know about composite materials in aircraft construction

UNIT-I

Introduction to aerospace materials and their classification– Properties of aerospace Materials-Airworthiness-Aerospace material design drivers – Properties required for aerospace structures, Engines and Rockets

UNIT-II

Mechanical and durability testing of aerospace materials – Aerospace materials certification-Structural health monitoring and non-destructive testing of aircraft components-Corrosion and corrosion testing of aerospace materials – Materials selection for aerospace, space environments and its effect on materials – stealth technology

UNIT-III

Materials for Gas turbines-Ni-based super alloys- Intermetallics-Ti-Al alloy
Thermal barrier coating. Materials for Rocket combustion chambers and Nozzles-Copper alloys-Cobalt base alloy- Stellite-Columbium alloy.

UNIT-IV

Non-ferrous and ferrous materials in aircraft construction: Al-Li alloys-Magnesium alloys-Titanium alloys-Super alloys -Stainless steels-Maraging steel

UNIT-V

Composite materials in aircraft construction: Composites-Polymer matrix composites-Carbon-Carbon composites-Ablative composites

Course Outcomes:

After completing the course, the student shall be :

1.Aquiring knowledge in requirement properties of aerospace materials
2.Getting knowledge of testing of aerospace materials.
3.Understanding the materials required for Gas turbines and Rocket combustion chambers.
4. Understand the ferrous and non ferrous materials required for aircraft construction
5. Understand the composite materials required for aircraft construction.

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√								√
CO2	√		√	√								√
CO3	√		√	√								√
CO4	√		√	√								√
CO5	√		√	√								√

Text Books

1.Adrian P Mouritz, Introduction to Aerospace Materials, Wood head publishing,2012
2.Aircraft Material and Processes Titterton G F Lienhard V English Book Store, New Delhi 5th Ed.,1998
3.Advanced Aerospace Materials H Buhl Springer, Berlin 1992

References

1.Reed.R.C., The Superalloys – Fundamentals and Applications, Cambridge Univ. Press,2009
2. Campell.F.C., Manufacturing Technology for Aerospace Structural Materials,Elsevier,2010

SYLLABUS FOR MINORS SUBJECTS

B.Tech MINORS	PHYSICAL METALLURGY	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. To understand the basic crystal structures of various materials which forms the basis for the subsequent study of properties of materials.
2. To understand the constitution and necessity of alloy formation.
3. The chapter outlines the various experimental methods of construction of phase diagrams.
4. The unit intended to describe various phase diagrams and phase transformations.
5. To provide the detailed explanation of phase transformations in steels.

UNIT – I

Structure of Metals, classification of metals, metallic bond-crystal structure of metals, coordination number, relationship between lattice parameter and atomic radius, packing factor and density calculations, interstitials, polymorphism, plane and directional indices, transformation of indices.

UNIT – II

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

UNIT – III

Equilibrium Diagrams: Experimental methods for construction of equilibrium diagrams, Isomorphous alloy systems, eutectic,partial eutectic systems and other systems.

Solidification: Types of Nucleation, determination of the size of critical nucleus, equilibrium cooling and heating of alloys, lever rule, coring, miscibility gaps. Simple problems using lever rule.

UNIT – IV

Transformation in solid-state, allotropy, order-disorder transformation, eutectoid, peritectoid reactions and complex phase diagrams, relation between equilibrium diagrams and physical properties of alloys. Study of important binary phase diagrams like Fe-Fe_3 C, Cu-Zn, Cu-Sn, and Al-Cu.

UNIT – V

Phase transformations in steels : pearlitic, martensitic and bainitic transformations:cooling curves. Isothermal transformation diagrams, transformations on continuous cooling.Concept of diffusion Ficks first law and second law.

Course Outcomes:

After completing the course, the student shall be able :

1. understand the geometry and crystallography of crystalline materials; Identify planes and directions in crystal systems.
2. apply the associated Hume Rothery rules for the formation of alloys.
3. outline the solidification behaviour of materials during cooling.
4. understand the concept of phase diagram in recognizing the phase changes
5. understand the importance of isothermal diagrams.

TEXTBOOK:

1. Introduction Physical Metallurgy – S.H. Avner- McGraw-Hill publishers
2. Physical Metallurgy – Viajyendra Singh, Standard Publishers Distribu rs, 2005

REFERENCES:

1. Physical Metallurgy principles-Reed Hill – CENGAGE Learning Publishers
2. Engineering Physical Metallurgy and Heat Treatment – Y. Laktin.
3. Elements of Physical Metallurgy – A.Guy
4. Metallographic labora ry practice – Kehl

B.Tech MINORS	THERMODYNAMICS AND KINETICS	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. The student can understand the basic concepts of the properties of a system to help them to get a clear understanding of reversible and irreversible processes.
2. The student can understand the clear concept of enthalpy and internal energy. It also helps in understanding the classification of work.
3. To understand the concepts of free energy and entropy.
4. To know the concepts of activity and equilibrium constants.
5. To understand the kinetics of chemical processes and simultaneous reactions. It helps the student toidentify, formulate and solve engineering problems

UNIT-I

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

UNIT-II

First and Second laws Law of thermodynamics: Nature of first law, relationship between heat and work, internal energy and the first law of thermodynamics, enthalpy change with temperature, Kirchhoff's equation. Second law of thermodynamics: Efficiency of a cyclic process, Carnot cycle, Carnot theorem, second law of thermodynamics, concept of entropy

UNIT-III

Third law of thermodynamics: Background of third law deductions from third law, applications of third law, and other methods of obtaining ΔS^0 for a reaction. determination of ΔG from thermal data useful relationships between free energies and other thermodynamic functions, Maxwell's equation and Gibbs-Helmholtz equation.

UNIT-IV

Fugacity, activity and equilibrium constant: Concepts of fugacity, activity and equilibrium constant variation of the equilibrium constant with temperature, Calculation of equilibrium constant from free energy changes, derivation of the Clausius – Clapeyron equation for single substance,

UNIT –V

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

Course Outcomes:

After completing the course, the student shall be able :

1. To apply the concepts and properties of system in engineering problems.
2. To understand systems concept of manufacturing processes.
3. To understand the relationship between these functions and their applications in various thermodynamic processes.
4. To identify, formulate and solve engineering problems.
5. To understand kinetics, order of a reaction and rate constants.

TEXTBOOK:

1. Introduction the thermodynamics of materials 5th Edition– D.R. Gaskell – CRC Press
2. Principles of metallurgical thermodynamics- S. K. Bose and S.K. Roy, University Press 2014

REFERENCES:

1. Thermodynamics of solids-R.S.Swalin
2. Physical chemistry of metals-L.S.Darken & Gurry
3. Physical Metallurgy Principles – RH Reed hill.
4. Thermodynamics An Engineering Approach – Cengel – Mcgraw-Hill – 7th Edition

B.Tech MINORS	HEAT TREATMENT	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. with principles of heat treatment, and different hardenability methods.
2. To learn about different surface hardening methods.
3. This topic throws light on TTT Curves and the effect of alloying elements on Fe-Fe_3C system.
4. This topic explains heat treatment of various types of tool, die steels and cast irons.
5. To understand the principles of heat treatment of various non-ferrous alloys

UNIT-I

Principles Of Heat Treatment: Austenitic Transformation, Pearlitic Transformation, Bainitic Transformation, Martensitic Transformation, Annealing, Normalizing, Hardening, mechanism of heat removal during quenching, quenching media, size and mass effect, hardenability, tempering,

UNIT-II

Surface heat treatment, carburizing, cyaniding, flame and induction hardening, residual stresses, deep freezing, thermomechanical treatments: Low and High temperature thermomechanical treatments,Ausforming, Isoforming, Cryoforming.

UNIT-III

Effect of Alloy Elements in Heat Treatment: Purpose of alloying, effect of alloying elements on ferrite, cementite, Fe- Fe_3C system, tempering, and TTT Curves.

UNIT-IV

Effect of Heat treatment on Alloy Steels: Structural and constructional steels, maraging steels, ol and die steels. Corrosion and heat resistant steels.

Effect of Heat treatment on Cast Irons: White cast iron, grey cast iron, spheroidal graphite iron, malleable cast iron, alloy cast iron.

UNIT-V

Heat treatment of Non-Ferrous Metals And Alloys: Precipitation hardening, aging treatment, the study of copper and its alloys, aluminium and its alloys, nickel and its alloys.

Course Outcomes:

After completing the course, the student shall be able :

1. To apply the concepts heat treatment in engineering problems.
2. To understand concept of different heat treatment processes.
3. To understand the iron carbide phase diagram ,concept of alloying
4. To understand heat treament concepts of Ferrous metals
5. To understand heat treament concepts of Non Ferrous metals

TEXTBOOK

1. Heat Treatment Principle and Techniques-Rajan & Sharma
2. Heat treatment of metals- Vijayendra Singh, 2nd edition, Standard Publishers Distribu rs, 2006

REFERENCES

1. Heat Treatment of metals-Zakharv-Mir Publishers
2. Physical Metallurgy Lakhtin-Mir Publishers
3. Physical Metallurgy - Clark and Varney
4. Physical Metallurgy Principles - Reed Hill
5. Physical metallurgy-Raghavan
6. Materials Science and Engineering, Adapted by R.Balasubramaniam, second edition, Wiley

B.Tech MINORS	**ENGINEERING MATERIALS**	**L**	**T**	**P**	**C**
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:

1. know about the structrual materials and they are used in engineering applications
2. know the Magentic materials properties and applications
3. know the Electrical materials properties and applications
4. know the Smart materials properties and applications
5. know various types of Bio materials

UNIT I:
Metals & Alloys, Structural Polymers, Ceramics, Intermetallics, Bulk Metallic Glasses, Amorphous Materials

UNIT II: Magnetic Materials
Ferri and Ferro magnetic materials; Soft Magnets; Hard Magnets; Fe-Si alloys; Fe-Ni Alloys; Ferrites and Garnets; Fine particle magnets; Giant magne resistance; Nanomagnetic materials.

UNIT III: Electronic Materials
Semi-conducting materials – concept of doping; compound semi-conduc rs – amorphous silicon, oxide semiconduc rs; amorphous semiconduc rs; MOSFET and CMOS

UNIT IV: Smart Materials
Shape memory alloys; rheological fluids,Piezoelectric materials

UNIT V: Biomaterials
Biocompatibility; Ti-implants; Hydroxyapatite; Bioactivity; Biopolymers,Bio ceramics

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

1. Learn all significant materials under one umbrella
2. design an advanced system based on magnetism with the knowledge on Magnetic Materials
3. design an advanced component by aquireing knowledge of Electronic Materials
4. Learn various fundamentals and concepts of various smart materials,
5. learn which materials can be used as bio materials and understand the concept of bio compactibilty and processing of biomaterials

Text books:

1. Materials Science and Engineering – W.Callister

References:

1. Material Science and Engineering – V. Raghavan
2. Park J.B. and Lakes R.S., Biomaterials: An Introduction
3. Mel Schwartz, " Encyclopedia of Smart Materials", Vol. I, John Wiley and Sons.

B.Tech MINORS	**WELDING TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. know the working principle, variables of welding process
2. know the working principle, merits and demerits of fusion welding processes
3. Understand the working principle and importance of welding allied processes
4. know the weldability and welding related problems of ferrous materials , various defects of welds
5. Learn weldability of various Non ferrous alloys

UNIT – I

The principles and theory, mechanism and key variables of different welding processes, types of oling and equipment. Microstructure of fusion and heat affected zone, welding stresses, pre and post treatments.

UNIT-II

Advantages, disadvantages and field of application of the welding with reference the following welding processes, Gas welding, Arc welding, submerged arc welding, TIG, MIG, MAG, CMT ,Plasma arc welding.

UNIT – III

Electron Beam welding , spot-welding, Laser welding, diffusion joining, Friction welding,Friction stir welding,ultrasonic welding and explosive welding, MIAB welding

UNIT-IV

Welding of structural steel, welding of cast iron, welding of stainless steel and other high-alloyed steels. Welding defects and remedies

UNIT-V

Welding of copper and its alloys, welding of aluminum and its alloys, joining of dissimilar alloys mechanism, Techniques and scope of brazing, soldering and adhesive bonding processes.

Course Outcomes:

After completing the course, the student shall be able :

1. Learn the fundamentals of Welding
2. Will develop basic welding skills in fusion welding processes
3. Will develop basic welding skills in welding alied processes
4. Analysis of weldment microstructure of ferrous materials

5. Analysis of weldment microstructure of Non ferrous materials

Text Book:

1. Welding Technology-R.S.Parmar**.**
2. A Textbook welding technology by O.P Khanna
3. Welding and welding technology by R L Little

Reference Books:

1. JF Lancaster: Welding Metallurgy
2. Little: Welding and Welding Technology

B.Tech MINORS	**FOUNDRY TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. know about various types of foundries and know the patterns and moulding sands and additives used for getting good moulds
2. know in detail about various casting processes and properties in moulds. Gating and risering in moulds
3. Study of different moulding processes and their equipment
4. Solidification of metals and alloys and melting practices be studied
5. Various casting defects and their prevention be studied

UNIT I

Scope and development of Foundry. Types of foundries. PATTERNS: Materials for patterns, types of patterns; functions and pattern allowance. MOULDING MATERIALS: Moulding sands, properties and selection of materials and additives used.

UNIT II

CASTING PROCESSES AND EQUIPMENT: Green and dry sand moulding; shell moulding, CO_2 moulding. Core moulds and cores. Plaster mould casting, composite mould casting, Investment casting.

GATING AND RISERING: Gate nomenclature, gate types and types of risers,Gating Ratio.

UNIT III

Permanent mould casting, pressure die-casting, Gravity die-casting and centrifugal casting, Types of moulding equipment.

UNIT IV

SOLIDIFICATION OF METALS: Nucleation crystal growth. Freezing of metals and alloys. Dendritic freezing. Coring and segregation, ingot defects, Flow of metals in moulds.

MELTING OF FERROUS ALLOYS: ‘Melting of Gray iron and cupola. Cupola operation and control. Melting of non-ferrous alloys: Melting of Aluminium and copper alloys production processes: Production of Gray Iron, ductile iron. Malleable iron castings

UNIT V

Continuous casting and casting defects: Casting defects arising due moulding, coring melting, and poring practice.solidification simulation.

Course Outcomes:

After completing the course, the student shall be able

1.Understand the sequence of foundry operations and testing of moulding and core sands
2.Classify different types of sand foundry Practices for casting
3.Distinguish different types of moulding processes and their advantages, disadvantages and applications
4.Alter the microstructure of the cast materials for different applications by changing the solidification pattern.
5.Design a suitable remedies avoid casting defects during the casting process.

TEXTBOOKS

1. Principles of Metal casting by Heine, Loper, and Rosenthal.
2. Foundry Technology – Dhuvendra Kumar & S.K.Jain

REFERENCE BOOKS

1. Metals Handbook Vol. 5 published by ASM, Ohio.
2. Foundry Technology-Jain
3. Foundry Technology Principles-T.V.Ramana Rao

B.Tech MINORS	**CORROSION ENGINEERING**	**L**	**T**	**P**	**C**
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. learn about electrochemical principles
2. learn about the Polarization and electrochemical behavior of metals
3. learn the principles and various types of corrsion
4. learn about various corrosion testing procedures and sequential procedure for labora ry and on-site corrosion investigations
5. understand various protective methods of corrosion

UNIT – I

Electrochemical and thermodynamic principles, Nernst equation and electrode potentials of metals, EMF and galvanic series, merits and demerits; origin of Pourbaix diagram and its importance iron, aluminium and magnesium metals

UNIT – II

Exchange current density, polarization- concentration, activation and resistance, Tafel equation; passivity, electrochemical behaviour of active/passive metals, theories of passivity

UNIT – III

Atmospheric, pitting, dealloying, stress corrosion cracking, intergranular corrosion, corrosion fatigue, erosion-corrosion, fretting corrosion and high temperature oxidation; hot corrosion; causes and remedial measures

UNIT – IV

Purpose of testing, labora ry, semi-plant and field tests, susceptibility tests for IGC, stress corrosion cracking and pitting, immersion and salt spray testing, impedance analysis, sequential procedure for labora ry and on-site corrosion investigations, corrosion auditing and corrosion map of India

UNIT – V

Corrosion prevention by design improvements, anodic and cathodic protection, metallic, non-metallic and inorganic coatings, mechanical and chemical methods and various corrosion inhibi rs

Course Outcomes:

After completing the course, the student shall be able

1. Learn basic principles related thermodynamics of corrosion phenomenon in metals & alloys
2. Learn basics of kinetics of electrochemical corrosion, relevant theories and equations.
3. manifestations of corrosion phenomenon through their origin, mechanisms and remedies
4. Learn Different methods of corrosion testing
5. Various corrosion preventive methods

Text Books:

1. Fontana M. G., Greene N.D., 'CorrosionEngineering',2nd Edition, McGrawHill,1983

Reference Books:

1. Raj Narayan, 'An Introduction Metallic Corrosion and itsPrevention',1stEdition, Oxford and IBH, 1983
2. Denny Jones, "Principles and Prevention of Corrosion", Prentice Hall of India,1996.

B.Tech MINORS	COMPOSITE MATERIALS	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. know various types of composite materials and their applications
2. Learn various types of fibers and their role as reinforcement in matrix material
3. Learn different processing methods of composites
4. learn different processing methods based on their application
5. understand how composites behave under various stress conditions.

UNIT-I

Introduction - Classification of composite materials based on structure, matrix andreinforcement.Advantages of composites - application of composites - functional requirements of reinforcement and matrix.

UNIT- II

Fibers: Preparation, properties and applications of glass fibers, carbon fibers, Kevlar fibers and metal fibers-properties and application of whiskers, particle reinforcements.

UNIT- III

Manufacturing of advanced composites: Polymer matrix composites: Preparation of Moulding compounds and – hand lay up method – Au clave method - Filament winding method - compression moulding – Reaction injection moulding.

UNIT- IV

Manufacturing of Metal Matrix Composites: Casting-Solid state diffusion technique. Cladding – Hot isostatic pressing. Manufacturing of Ceramic Matrix Composites: Liquid Metal infiltration-Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving

UNIT- V

Response of Composites Stress: (a) Iso strain condition (b) Iso Stress condition (c) Load friction shared by the fiber

Course Outcomes:

After completing the course, the student shall be able

1.Define and differentiate composite materials on the basis of properties

2.Analyze different fibers used as reinforcements in composites
3.Demonstrate the utilization of polymer composites in various applications
4.Demonstrate the utilization of Metal and ceramic matrix composites in various applications
5.Learn Mechanical behaviour of composite materials

Text Books:

1. Composite Materials-K.K.Chawla, Springer, 2nd Edition, 1998
2. An introduction composite materials, D. Hull an T.W. Clyne, 2nd edition, Cambridgeg University press, 1996

Reference Books:

1. Composites ASM Hand Book, Vol. 21, 9th edition, 1989
2. Fundamentals of composites: Materials, manufacturing, methods an applications, Society of manufacturing engineers, 1989
3. Material Sciences and Technology – (R.. W. Cahn, P. Haasen, E, J, Kramer eds.) Vol 13
4. Structure and properties of composites (T. W. Chou ed.) VCH Winheim, 1993 – Composites by Cahn – VCH

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B.Tech MINORS	MATERIAL CHARACTERIZATION	L	T	P	C
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:
1. understand various characterization techniques for solids
2. understand spectroscopy and optical microscopy characterization techniques
3. understand Electron microscopy methods of characterization
4. learn different thermal methods of characterization
5. know the Diffraction methods of characterization with focus on XRD

UNIT –I
Introduction: Scope of subject, classification of techniques for characterization, macro and micro-characterization structure of solids.

UNIT –II
Spectroscopy: A mic absorption spectroscopy, infraredspectroscopy and Raman spectroscopy.
Metallographic Techniques: Optical metallography, image analysis, quantitative phase estimation.

UNIT –III
Electron optical Methods: Scanning electron microscopy and image formation in the SEM.
Scanning probe microscopy - A mic force microscopy (AFM), scanning tunnelling microscope (STM),

UNIT –IV
Diffraction Methods: X-ray diffraction (Bragg law, powder diffraction and phase identification, structure fac r,estimation of crystallite size and strain; residual stress measurement single crystal diffraction).

UNIT -V
Bulk Averaging Techniques: Thermal analysis, DTA, DSC, TGA, dila metry,resistivity/conductivity.

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

1.Understand the classification various techniques for material characterization

2.Explain the principles of microscopy and perform quantitative analysis of microstructures
3.Prepare samples and analyse microstructure using scanning and transmission electron microscopes
4.Demonstrate the various application the x-ray diffraction techniques for material characterization
5.Analyse and characterize the materials using different thermal analysis

Text Books:

3. The Principles of metallogrphy labora ry practices –George L.Khel-Eurasia publishing house (Pvt Ltd)
2. Transmission electron Microscopy of metals –Garet Thomas.-John wiley and sons.

Reference Books:

5. Modern Metallographic Techniques & their application – vic r phillips.
6. Physical Metallurgy, Part – I – RW Chao and P. Haasan.
7. Experimental Techniques in Physical Metallurgy – VT Cherepin and AK Mallik.
8. Electron Microscopy in the study of materials –P.J.Grundy.

B.Tech MINORS	MATERIALS TESTING	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge

1.The pic deals with various types of dislocations, slip and twinning
2. understand the principles of various hardness tests and theories of fracture
3. understand the principle of tensile test, compression Test
4. know the fundamentals,failure and the fac rs affecting fatigue and creep
5. know the non-destructive testing methods and evaluation of flaws inmaterials

UNIT- I

Metallurgical Fundamentals: Critical resolved shear stress. Defects in crystalline materials The concept and types of dislocation, Interaction between dislocations, sessile dislocation, glissile dislocation, Energy of a dislocation, dislocation climb, Jogs, Forces on dislocations. Frank Reed source, slip and twinning.

UNIT- II

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

Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, , significance of transition temperature curve, Metallurgical fac rs affecting on transition temperature, temper embrittlement.

UNIT – III

Tension Test: Mechanism of elastic action, linear elastic properties. Engineering stress strainand True stress-strain curve. Tensile properties, conditions for necking, effect of temperature and strain rate on tensile properties.

Compression Test: Elastic and in-elastic action in compression, elastic and in-elastic properties in compression.

UNIT – IV

Fatigue Test: Introduction, Stress cycles, S-N Curve, Effect of mean stress, Mechanismof 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.

Creep Test: 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.

UNIT- V

Non-Destructive Tests: Introduction, various NDT methods, applications advantages of one test over the other.

Course Outcomes:

After completing the course, the student shall be able

1. Will be able learn fundamentals of mechanical metallurgy
2. Analyse the test sample by using different hardness testing methods
3. Analyse the test sample by using compression and tension testings
4. Learn the concepts of Fatigue and creep tests sample
5. Conduct NDT Investigations on engineering components

Text Books:

1. Mechanical Metallurgy - GE Dieter

Reference Books:

1. Engineering Materials Science - CW Richards
2. Mechanical behavior of material-A.H.Courteny
3. Mechanical behavior-Ed.Wulf

B.Tech MINORS	INTRODUCTION TO MATERIALS SCIENCE	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. learn about the fundamentals of crystal structure, defects
2. learn about the fundamentals of dislocations and their interaction
3. learn about the electrical and magnetic Properties of materials
4. learn about the optical Properties of materials
5. learn about the Properties of advance materials

UNIT - I

Introduction: classification of materials**,** Space lattice and unit cells,
Crystal systems: Indices for planes and directions. Structures of common metallic materials.
Crystal defects: Point, Line and surface defects. Dislocations,types of dislocations

UNIT - II

Dislocation movement by slip, climb and cross slip. Dislocation sources,dislocation interaction.
Slip systems for BCC, FCC and HCP metals, Critical resolved shear stress (CRSS) for slip, Twinning, Stacking faults, Jogs, Kinks. Strengthening mechanisms

UNIT - III

Electrical and Electronic properties of materials, Electronic conductivity, free electron theory and band theory of solids. Intrinsic semi-conduc rs.Super conductivity.
Dia, para, ferro, ferri magnetism in materials , Soft and hard magnetic materials and applications.

UNIT - IV

Optical properties of materials.Refractive index, absorption emission of light, optical fibers.Op -electronic materials.

UNIT-V

Bulk metallic glasses,quasi crystals,nano crystalline materials ,amorphus materials and their Properties

Course Outcomes:

After completing the course, the student shall be able

1.Understand basics of materials science and engineering
2.Learn fundamentals of disloction interaction
3.Learn and Develop materials with specific electrical and magnetic properties

4.Learn and Develop materials with specific optical properties
5.Aquire knowledge on advance materials

Text books:

1. Material Science and Engineering by V.Raghavan
2. Physical Metallurgy by S. H. Avner.

Reference books:

1. Material Science and Engineering by L.H.VanVleck, 5th edition, AddisionWealey(1985)
2. Structure and properties of Materials by R.M.Rose, L.A.Shepard and J.Wulff, Vol.1,4 John Willey (1966) .
3. Essentials of Material Science by A.G.Guy, McGraw Hill(1976).
4. The Science and Engineering Materials by D.R.Askeland. 2nd Edition, Chapman and Hall (1990).
5. Physical Metallurgy, Vijendra Singh

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B.Tech MINORS	NON METALLIC MATERIALS	L	T	P	C
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:
1. learn about the classification of non metallic materials
2. learn about the glasses and glass formation
3. learn about the composte materials
4. learn about the ceramic materials and their fabrication
5. learn about the electrical,magnetic and thermal Properties of materials

Unit I
Definition and classification of nonmetallic materials, comparison of properties of metals and nonmetallic materials. Introduction Polymers: Concept of polymers, types of polymers reactions, Mechanism of polymerization, Synthesis, properties and application of some of the significant polymers viz., PVC, PAN, PMMA, and Teflon

Unit II
Glasses: Introduction, formation of glasses, structural features of glasses, classification, processing and applications of glasses. Manufacturing methods of glasses.

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

Unit IV
Classification of ceramics: crystal structures and properties, fabrication of ceramic products from powders: pressing, casting, vapour phase techniques, sintering, finishing, machining. ceramic coatings

Unit V
Electrical, magnetic and thermal properties of non - metallic materials

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

1.learn selection different non metallic materials for specific engineering application
2.learn how glasses are formed and different types of glasses
3.selection criterion for composites for various engineering applications
4.selection criterion for ceramics for various engineering applications
5.aquire knowledge on properties of non metallic materials

Text Books:

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

Reference Book:

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

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B.Tech MINORS	NANO MATERIALS	L	T	P	C
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:
1. understand importance of nano materials and applications of various nano materials
2. know about the different synthesis processes used for getting nano materials
3. understand the mechanical behaviour of nano materials under various conditions
4. know about the electrical and optical phenomena of nano materials
5. know about the various characterization techniques used for seeing nano materials

UNIT-I
General Introduction1-D ,2-D, 3-D nano structured materials, applications of Nano materials Synthesis of Nano materials- p-down approach and Bot m-Up approach,
UNIT-II
Nanoparticle synthesis by Chemical Methods and Mechanical Methods
UNIT-III
Mechanical Behaviour, Anamolos Deformation behavior of nanosturctutredmaterials ,Room temperature creep
UNIT-IV
Electrical Properties: Switching glasses with nanoparticles,Electronic conduction with nanoparticles
Optical Properties: Optical properties, special properties and the coloured glasses
UNIT-V
Structural characterization: Electron microscopy, scanning probe microscopy for nano science and technology, X-ray diffraction.
Course Outcomes:
After completing the course, the student shall be able

1.learn basics of nano materials and their classification
2. learn different synthesis routes according get nano materias.
3.Know the mechanical behaviour of nano materials
4. learn prpoperties of nano materials
5.uasge of characterization techniques see nano materials

Text Books
1. Textbook of nanoscience and nanotechnology, B.S. Murty et al. Universities Press 2012
2. Nano: the essentials- T.Pradeep, Tata McGrawHill Publishers, 2007

Reference Books:
1. Introduction nanotechnology, Charles P. Poole, Wiley publishers, 2003

B.Tech MINORS	POWDER METALLURGY	L	T	P	C
		3	1	0	4

Course Objectives:

The students will acquire the knowledge:

1. get acquainted with the importance of powder metallurgy
2. get acquainted with various powder production method

3.study the mechanism of compaction and sintering

4. gain knowledge on various applications of powder metallurgy parts
5. get acquainted with the advanced powder metallurgy materials

UNIT – I

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

UNIT – II

Characterization and production of powders: General characteristics of metal powders, particleshape flow rate, apparent density, and specific surface area, particle size distribution.

Determination of powder characteristics; different methods of production of metal powders:influence of manufacturing process on powder characteristics

UNIT – III

Consolidation of Metal Powders: Compaction - Theory of consolidation: Pressure transmissioninpowders; compressibility and compactibility of powders; Green strength; Powder rolling. Sintering - Mechanisms of Sintering; Fac rs affecting sintering; Activated sintering; Liquid phase sintering; Sintering atmospheres; Properties of sintered parts, Hot isostatic pressing , spark palsma sintering. Properties of sintered parts.

UNIT – IV

Applications: Porous parts: Self-lubricating bearings, filters: Dispersion strengthened materials: Cu /Al2O3, Sintered Aluminum Powder.

UNIT –V

Electrical and Magnetic materials, Tungsten lamp filaments, electrical contacts, welding electrodes.Soft magnetic materials (Fe, Fe-N); Permanent magnets (Alnico, SnCo5), Cemented carbides; Cermets.

Course Outcomes:

After completing the course, the student shall be able

1.Know the advantages of PM techniques over other fabrication techniques

2.Get an idea of powder production and powder characterization

3. learn the sintering mechanisms of powder metallurgy

4.learn the applicatrions of powder metallurgy

5.have knowledge on how advanced materials can be made in powder metallurgy route

Text Books:

1. Powder Metallurgy: Anish Upadhya and GS Upadhya- University Press, 2013
2. Powder Metallurgy, P.C. Angelo and R. Subramanian, PHI Pvt. Ltd., 2008
3. Powder Metallurgy and particulate materials processing by RM German

References Books:

1. Powder Metallurgy, ASM Metals Hand Book , Vol. 7, 1984
2. Powder Metallurgy Science, Randall M. German, 1994

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B.Tech MINORS	SMART MATERIALS	L	T	P	C
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:
1. have insight in the latest developments regarding smart materials
2. know principals of Magne strictive materials
3. learn important polymers which are used as smart materials
4. know the importance and properties of shape mempry alloys
5. learn about sensor materials and energy materials

UNIT-I
Introduction Smart Materials, Principles of Piezoelectricty, Perovskyte Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers.

UNIT-II
Principles of Magne striction Rare earth Magne strictive materials, Giant Magne striction and Magne -resistance Effect

UNIT-III
Introduction Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC)

UNIT-IV
Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magne Rhelological Fluids

UNIT-V
Piezeoelctric Strain Sensors, Self Healing Polymers**,**smart composites, Energy Harvesting Materials

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

1.Learn about various smart materials
2.Learn the properties of Magne strictive materials
3.Learn about advance polymer materials usage as In smart devices
4.understand shape memory alloy effect
5.understand smart sensor systems and energy materials

Text Books

1. Brian Culshaw, Smart Structures and Materials, Artech House, 2000
2.Gauenzi, P., Smart Structures, Wiley, 2009
3.Cady, W. G., Piezoelectricity, Dover Publication

B.Tech MINORS	DESIGN AND SELECTION OF MATERIALS	L	T	P	C
		3	1	0	4

Course Objectives:
The students will acquire the knowledge:

1. know different types of materials and propertiesfor material selection
2. know effect of microstructure on the prpoerties
3. know how propertires deine performance of a component with some examples
4. study shape factor,MPI, shape effeicency with some case studies
5. understand material selection based on design aspect

UNIT - I
Materials selection process: Criteria for selection of materials, The Ashby process of Material Selection
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, design of an alloy for fission and fusion reac rs.
UNIT – IV
Introduction Shape Fac r,Inclusion of Shape Fac r in the Material Property Index (MPI),Limits in Shape Efficiency of Different Materials,Case studies.

UNIT - V
Materials aspects of design: Selection and design of polymers, ceramics and composites for specific applications
Course Outcomes:
After completing the course, the student shall be able

1.Understand types of materials and properties
2.Learn how materials selection is done
3.Learn Selection of materials for Specific engineering applications based on their performance
4.Understand importance of shape efficinency in applications
5.Classify and evaluate selection of materials based on the design

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