Course Syllabus
Gyanmanjari Institute of Technology
Semester-2 (B.Tech.)

Subject : Material Science and Metallurgy - BETME12302

Type of course: Undergraduate

Prerequisite: NA

Rationale: To Understand the basic knowledge of different material and behavior in different conditions

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
3	0	2	4	60	30	10	20	30	150

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Sr. No	Course content	Hrs	% Weightage
1	**An Overview of Metallurgy and Material Science** Fundamentals of Engineering Materials: Classifications and Uses , the fundamentals of advanced engineering materials, the materials' engineering needs, their properties, selection criteria for materials used in engineering applications.	4	8
2	**Crystal imperfection and solidification**	5	12

	Miller indices, coordination number, single cell, Bravise lattice, atomic packing, metallic element crystal structures, crystal planes and orientations, and crystal structure allotrophy or polymorphism.		
3	**Allotropy of Iron and I-C Diagram** Allotropy of Iron, Iron-Iron carbide diagram, various phases of it, Importance of it on mechanical engineering General properties of the Iron-Iron Carbide equilibrium system's alloy groups (Wrought Irons, Steels, and Cast Irons).	7	18
4	**Heat treatment and application on mechanical parts** Time-Temperature-Transformation diagram, The study of heat treatment procedures including carburizing, nitriding, cyaniding, induction hardening, flame hardening, annealing, normalizing, spherodizing, hardening, tempering, and hardenability of steel.	8	18
5	**Powder Metallurgy** Powder metallurgy applications, benefits, manufacturing procedures, powder production, compacting, sintering, and powder metallurgy products.	6	12
6	**Non-Destructive testing** Non-destructive testing methods include dye penetration, ultrasonic, magnetic particle, radiography, and penetration testing. relative benefits, drawbacks, and uses.	8	15
7	**Metal and alloy corrosion:** corrosion mechanisms, corrosion kinds, and corrosion preventive methods.	4	9
8	**Material alloys and Advance material** Alloy Types and Properties, Composite Materials Nanomaterials	3	8

Continuous Assessment (ALA):

Sr. No	Active Learning Activities	Marks
1.	**Material Selection Project:** Divide the class into groups and assign them a specific engineering application (e.g., designing a bicycle frame or a car component). Each group must research and select the most suitable materials based on cost, mechanical properties, and other criteria. They can present their material selection choices to the class, justifying their decisions. This project helps students understand the importance of material selection and its real-world implications.upload it on GMIU web portal	10
2.	**Quiz-Heat Treatment Simulation** Quiz to understand heat treatment principles. (20 Mcqs)	10
3	**Material Property Role-Play:** (Make a video) Assessment Criteria: Accuracy of material description, effective presentation and upload it on GMIU web portal.	10
Total		30

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (**Revised Bloom's Taxonomy**)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	30%	50%	20%	-	-	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Understand basic concept of material science and crystal imperfection
CO2	Learn the behaviour of Iron and various phases of I-C Diagram
CO3	Study the importance of heat treatment on material for mechanical parts
CO4	Understand the powder metallurgy process and NDT

CO5	Create specimen for testing of parts
CO6	Learn various composition of alloys and available advance material in market

List of Practical

Sr. No	Descriptions	Unit No	Hrs
1	To understand the mechanical properties and behavior of various alloys through tensile testing.	1	4
2	To determine crystal structures of materials and understand their importance in material science.	2	4
3	To identify and analyze the phases in the Iron-Iron Carbide diagram for mechanical engineering applications.	3	4
4	To familiarize students with non-destructive testing techniques and their practical use in industry.	6	6
5	To demonstrate the principles and applications of powder metallurgy in manufacturing	6	4
6	To explore the properties and applications of various alloy types, including composite materials.	8	4
7	To investigate corrosion mechanisms and evaluate preventive methods for different materials.	8	4
	Total		30

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

[1] Physical Metallurgy, Sydney H. Avner, Tata McGraw-Hill.

[2] Elements of Material Science and Engineering, Lawrence H. Van Vlack, Pearson

[3] The Science and Engineering of Materials Donald R. Askeland and Pradeep P. Phule

[4] Callister's Material Science and Engineering, R. Balasubramaniam, Wiley India.