SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology

Bachelor of Technology

Mechanical Engineering Department

B. Tech. Open elective

Course Name: **Material Science & Metallurgy** **Course Code: BTME15506**

Type of course: **Open Elective Course**

Prerequisite: Basic Understanding of Materials.

Rationale of Course: Basic principles of science are used to study the structure-properties relationships of various materials for their proper applications in this subject. Especially study of different types of ferrous and non-ferrous metals and alloys, in terms of their composition, structure, properties and applications; non-destructive testing are included in this course to understand the basic concept of selection and processing of metals and materials for their applications.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in the course.

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Introduction to Material Science and Metallurgy:** Basics of Engineering Materials, their Classifications and Application, Basics of Advance Engineering Materials, Engineering requirements of materials, Criteria for selection of materials for engineering applications.	05	10%

Sr. No.	Topics	Teaching Hrs.	Module Weightage
2	**Crystal Geometry and Crystal Imperfection**: Miller indices, Crystal structure and correlated properties. Diffusion processes; **Crystallization**: Mechanism of crystallization - nucleation and growth, factors influencing nucleation and growth. Solidification and Theory of Alloys: Solidification of metals and an alloy, Nucleation and Growth during freezing of pure metal and alloy ingot/a casting Resultant macrostructures;	**09**	**20%**
3	**Metallic Materials:** Types, properties and applications, Structure of Metals, Fracture, Macro-examination, Spark Test, Microscopic examinations, Magnetic Testing, chemical analysis of steel and iron for Carbon, phosphorus and Sulphur. Phase and phase equilibrium: Unary and Binary equilibrium phase diagrams.	**05**	**10%**
4	**Powder Metallurgy:** Application and advantages, Production of powder, Compacting, Sintering, Equipment and process capability.	**05**	**10%**
5	**Allotropy of Iron, Iron-Iron Carbon equilibrium diagram:** Allotropy of iron; Iron-iron carbon diagram: Phases present and their properties and its different reactions.	**07**	**15%**
6	**TTT diagram and Heat Treatment of Steel:** Time-Temperature-Transformation Diagram, Isothermal and continuous transformations. Heat treatment processes such as annealing, normalizing, sherardizing, hardening, tempering, carburizing, nitriding, cyaniding, induction hardening, flame hardening and hardenability of steel.	**08**	**20%**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
7	**Non-Destructive Testing:** Non-Destructive testing of materials such as Radiography Testing, Dye Penetration Testing, Magnetic Particle Testing, Ultrasonic Testing. Eddy current testing with their principle of non-destructive testing, the test methods, relative merits, demerits and applications.	06	15%

Percentage Distribution of Marks as per Bloom's Taxonomy (Theory/Practical):

Percentage Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	30	20	10	10	05

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyse, **E:** Evaluate **C:** Create and above Levels

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.

Reference Text Books:

Sr. No	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Callister's Material Science and Engineering	R. Balasubramaniam	Wiley India.	2014	2nd
2.	Elements of Material Science and Engineering	Lawrence H. Van Vlack,	Pearson Education.	2002	6th
3.	The Science and Engineering of Materials	Donald R. Askeland and Pradeep P. Phule,	Cengage Learning.	2010	6th
4.	Principles of Materials Science and Engineering	W F Smith,	McGraw Hill.	1995	3rd

5.	Practical Non-Destructive Testing.	Baldev Raj, T. Jayakumar and M. Thavasimuthu	Narosa Pub. House.	2017	3rd

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Extend and define the knowledge of basic concept of Material Science and Metallurgy	20
CO-2	Interpret and relate the Properties and applications of ferrous and nonferrous metals, alloys and other materials.	40
CO-3	Experiment with different non-destructive testing methods	20
CO-4	Analyse phase change and related parameters.	10
CO-5	Judge the Scope and limitations of different materials and its environmental as well as economic impact.	10

Mapping with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	0	1	0	2	1	2	0	0	0	0	3			
CO-2	3	1	1	0	0	2	2	0	0	0	0	3			
CO-3	3	3	3	2	3	3	3	0	2	1	0	3			
CO-4	3	3	3	2	3	3	3	0	2	1	0	3			
CO-5	3	2	3	2	3	3	3	3	3	3	3	3			
Rationale*	**15**	**9**	**11**	**6**	**11**	**12**	**13**	**3**	**7**	**5**	**3**	**15**			

***Rationale of CO-PO mapping*:**
It states that the course develops understanding of Engineering knowledge, Design / development of solutions, Modern tool usage, The engineer and society, Environment and sustainability, New Technologies for lifelong learning. This Course also focuses on Problem analysis, Conduct investigations of complex problems, Ethics, Individual and teamwork, Communication, Project management and finance.

This course highly maps with Program outcomes 1,3,5,6,7,12. It states that the course will develop Engineering knowledge, Design / development of solutions, Modern tool usage, the engineer and society, Environment and sustainability, Life-long learning.

List of Practical:

1. Preparation and study of crystal models for simple cubic, body centred cubic, Face centred cubic and hexagonal close packed structured
2. The construction and working of a metallographic microscope.
3. Preparation of specimen for microscopic observation.
4. Understanding of Microscopy, and how it can be used to observe Microstructure of Ferrous metals.
5. Understanding of Microscopy, and how it can be used to observe Microstructure of nonferrous metals.
6. Identification of the different types of material available for design, manufacturing and processing of various components based on structure-property-performance processing relationships.
7. Analyse the heat treatment processes such as annealing, normalizing, sherardizing, hardening, tempering, carburizing, nitriding, cyaniding, induction hardening, flame hardening and hardenability of steel.
8. Characterization of Non-Destructive Testing: Dye Penetration Test

Major Equipment:

1. Metallurgical Microscope with Computerized Image Analysis System with standard Specimen Set of Steel, Cast Iron and Non-Ferrous Metals and Alloys
2. Muffle Furnace
3. Standard Specimens of Steels and Cast Iron for Heat Treatment
4. Hardness Testing machine
5. Universal Testing Machine.