CVM UNIVERSITY
Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Mechanical Engineering)**

Semester: **III**

Course Code: **202090303**

Course Title: **Material Science And Metallurgy**

Course Group: **Engineering Science Course**

Course Objectives: The course is intended to strengthen the fundamentals of material science and metallurgy by imparting the knowledge about basic structure of materials, their classification, effect of structure on properties of the materials

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 9	25 / 9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction** Basic understanding of material science and metallurgy, Classification of engineering materials including ceramics, glasses, composites and advanced materials, such as, smart materials, nano materials, super conducting material, and optic fibres, Concepts of stress and strain, Stress-Strain diagrams; tensile test; Elastic deformation, Plastic deformation. Toughness behavior, Impact Testing. Hardness of materials, criteria for selection of material for any application.	10
2	**Crystal Structure:** Basic understanding of crystallography, Crystalline and amorphous solids, Lattices, Bravais lattices, unit cells, crystal systems, Miller indices, indexing of direction and planes, co-ordination number, packing factors, polymorphism. Imperfections: Point defects, Line defects, surface defects – grain boundary, twin boundary, Grain, Grain size number. Burgers vectors.	07
3	**Crystallization:** Mechanism of crystallization - nucleation and growth, Imperfections in crystals and their effect on properties, Solute strengthening.	04

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4	**Phase diagram:** Concept of phases, Gibb's phase rule, Binary phase diagram and its types, solid solution – Hume Rothery Rules. Different reactions like eutectic, eutectoid, peritectic and peritectoid; Non-equilibrium cooling.	**07**
5	**Iron-Iron Carbide equilibrium diagram:** Allotropy of Iron, Iron-iron carbide equilibrium diagram, different reactions, steels, cast iron, Different specifications and designations of steels, application of CI and steels.	**05**
6	**Heat Treatment of Steel:** TTT diagrams, CCT diagrams, heat treatment processes: annealing, normalizing, spherodizing, hardening, tempering, carburizing, nitriding, cyaniding, induction hardening, flame hardening, hardenability of steel.	**06**
7	**Powder Metallurgy:** Applications of powder metallurgy, advantages of powder metallurgy, manufacturing processes, production of powder, compacting, sintering, products of powder metallurgy	**03**
8	**Non-Destructive Testing:** Introduction to Destructive and Non-Destructive testing (NDT) methods, uses of NDT, Dye Penetration Testing, Magnetic Particle Testing, Radiography Testing, Ultrasonic Testing. Eddy current testing, Advantages, disadvantages, applications of NDT methods	**03**
	Total	**45**

List of Practicals / Tutorials:

1	Concept of crystal structure.
2	Metallurgical Microscope.
3	Preparation of specimen for micro examination.
4	Phase diagram & its application, Iron-Iron Carbide equilibrium diagram.
5	Heat treatment of material and comparative study of effect of different quenching medium.
6	Rockwell and Brinell hardness test.
7	Jominy hardenability Test.
8	Understanding of powder metallurgy.
9	Liquid Penetrant Test, Magnetic Particle Test.
10	Eddy Current Test, Ultrasonic Test.

Reference Books:

1	Callister's Material Science and Engineering, R. Balasubramaniam, Wiley India.
2	Physical Metallurgy, Sydney H. Avner, Tata McGraw-Hill.
3	Raghavan V (2007), Materials Science and Engineering - A First Course, Prentice Hall, India
4	Elements of Material Science and Engineering, Lawrence H. Van Vlack, Pearson Education.
5	The Science and Engineering of Materials Donald R. Askeland and Pradeep P. Phule, Cengage Learning.
6	Principles of Materials Science and Engineering, W F Smith, McGraw Hill.
7	Materials Science and Metallurgy, K. I. Parashivamurthy, Pearson Education.

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8	Practical Non-Destructive Testing, Baldev Raj, T. Jayakumar and M. Thavasimuthu, Narosa Pub. House. ASM Handbook Vol.
9	Metallography and Microstructure, Ed. George F. Vander Voort, ASM International 2004.

Supplementary learning Material:	
1	NPTEL resources

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Industrial/ Field visits

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
20%	15%	10%	40%	15%	0 %	

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 Outcomes (CO):

Sr.	**Course Outcome Statements**	**%weightage**
CO-1	Acquainted with the basic concepts of Material Science and Metallurgy.	**20**
CO-2	Analyze the phase diagram and its application.	**30**
CO-3	Utilize the concept of properties of materials.	**20**
CO-4	Acquainted with the Powder Metallurgy and its applications.	**15**
CO-5	Acquainted with the NDT and its application	**15**

Curriculum Revision:	
Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	--
Next Review on (Month-Year):	June-2025

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