## JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE, JAIPUR DEPARTMENT OF MECHANICAL ENGINEERING

**Name of Subject :-** Material science and Engineering

**Subject Code :-** 3ME4-06:

**Year :- 2nd Year 3rd Semester**

**Name of Faculty :- 1) Mr. Hukam chand Assistant Professor**

### RAJASTHAN TECHNICAL UNIVERSITY, KOTA

**Syllabus**

**2nd Year – 3rd Semester: B.Tech. : Mechanical Engineering**

**3ME4-06:Material science and Engineering**

**Credit: 3 Max. Marks: 150(IA:30, ETE:120)**

**3L+0T+0P End Term Exam: 3Hours**

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| **SN** |  | **Hours** |
| **1** | Crystal structure – BCC, FCC and HCP, unit cell, crystallographic  planes and directions, miller indices. Crystal imperfections, point,line, surface and volume defects.  . | **3** |
| Frank Reed source of dislocation, Elastic & plastic modes of  deformation, Bauschinger's effect, slip & twinning, strain hardening,cold/hot working recovery, re-crystallization and grain growth | **4** |
| **2** | Classification of Engineering Materials: Solidification of metals and of some typical alloys, mechanism of crystallization (I) nuclear formation(ii) crystal growth, general principles of phase transformation in alloys,phase rule and equilibrium diagrams, equilibrium diagram of binarysystem having complete mutual solubility in liquid state and limited solubility in solid state, binary isomorphous alloy system, Hume-Rothery rule , binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with a peritectic transformation, equilibrium diagram of a system whose components are subject to allotropic change. | **5** |
| Iron carbon equilibrium diagram, phase transformation in the iron carbon diagram, eutectic, peritectic, eutectoid and peritectoid reactions and microstructures.. | **3** |
| **3** | Isothermal transformation diagrams –cooling curves superimposed on Isothermal Transformation diagram, critical cooling rate. (i) Formation of Austenite from Pearlite  (ii) Transformation of Austenite into Pearlite. | **4** |
| Full annealing, stress relief, spheroidizing – normalizing, hardening and tempering of steel. Hardenability, Jominey end quench test –Austempering, martempering. Case hardening, carburising, nitriding,cyaniding, carbonitriding. Flame and Induction hardening | **4** |
| **4** | Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC,PMMA, PET, PC, PA, ABS, PI, PAI, PPO,PPS, PEEK, PTFE Polymers.  Urea and Phenol formaldehydes. | **4** |
| Constitution of alloys: Solid solutions - substitutional and interstitial.Ferrous and Non Ferrous Metals- Effect of alloying additions on steel(Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA steel. | **4** |
| **5** | Mechanical Properties and Testing: Types of fracture, testing of materials under tension, compression and shear loads – hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy, fatigue and creep test.. | **4** |
| Classification of steels and cast iron constitution and properties. BIS standards.Engineering Ceramics – Properties and applications of Al2O3, SiC,Si3N4, PSZ etc. Fiber and particulate reinforced composites and resin  plastics.Introduction to Nano materials- Nano structured materials. Nano clusters & Nano crystals | **3** |

**COURSE OUTCOME**

After studying this subject, student will be able

**CO-1** students will be able to **recognize** the basic crystal structure and classification of material

**CO-2** Students will be able to **interpret** the basic mechanical properties.

**CO-3** Students will be able to **categorise** the different phase of material with the help of carbon diagram.

**CO-4** students will be able to **select** different heat treatment method according to the properties required for material

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|  | |  | |  | | **PO1** | | **PO2** | | **PO3** | | **PO4** | | **PO5** | | **PO6** | | **PO7** | | **PO8** | | **PO9** | | **PO10** | | **PO11** | | **PO12** | | **PSO1** | | **PSO2** | |
| **3ME4-05** | | **Material science and engineering** | | CO-1 | | 2 | | 2 | | 2 | | 3 | | 2 | | 3 | | 2 | | 3 | | 2 | | 2 | | 3 | | 3 | | 2 | | 2 | |
| CO-2 | | 2 | | 3 | | 2 | | 3 | | 2 | | 3 | | 3 | | 1 | | 3 | | 3 | | 2 | | 1 | | 2 | | 2 | |
| CO-3 | | 3 | | 2 | | 2 | | 3 | | 3 | | 3 | | 3 | | 3 | | 3 | | 3 | | 3 | | 3 | | 2 | | 2 | |
| CO-4 | | 2 | | 2 | | 3 | | 2 | | 3 | | 3 | | 2 | | 3 | | 3 | | 2 | | 3 | | 3 | | 2 | | 2 | |

### Material science and Engineering (3ME4-06)

### Hukam chand

### Vision and Mission of Institute:

Vision: To become a renowned center of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

Mission:

M1: Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

M2: Identify, based on informed perception of Indian, regional and global needs, areas of focus and provide platform to gain knowledge and solutions.

M3: Offer opportunities for interaction between academia and industry.

M4: Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

### Vision and Mission of Department:

Vision: The Mechanical Engineering Department strives to be recognized globally for excellent technical knowledge and to produce quality human resource, who can manage the advance technologies and contribute to society through entrepreneurship and leadership.

Mission:

M1: To impart highest quality technical knowledge to the learners to make them globally competitive mechanical engineers.

M2: To provide the learners ethical guidelines along with excellent academic environment for a long productive career.

M3: To promote industry-institute linkage.

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| **Lect. No.** | **Topics to be discussed** | **Relevant COs** | **Objective of unit** | **Outcome of Lecture (After completion of this lecture students will be able to)** |
| 1 | Introduction to Matrial science engineering | CO1 | To understand the basic concepts of atomic structure, bonding and crystal structure . | Understand the basic concept of material science engineering |
| 2 | Crystal structure | CO1 | understand the concept of crystal structure |
| 3 | Crystal parameters |  | understand the concept of crystal structure |
| 4 | crystallographic | CO1 | Understand the crysallographic planes |
| 5 | planes and directions, miller indices | CO1 | Understand the types of crystal planes and miller indices |
| 6 | Crystal imperfections | CO1 | Understand crystal imperfections |
| 7 | Crystal Dislocation | CO1 | Identify the types of crystal imperfection |
| 8 | Crystal Dislocation (Continue) | CO1 | Identify the types of dislocation . |
| 9 | strain hardening | CO1 | understand the concept of strain hardning . |
| 10 | strain hardening (Continue) | CO1 | understand the principle of cold/hot working . |
| 11 | cold/hot working | CO1 | understand the principle of cold/hot working . |
| 12 | cold/hot working (Continue) | CO1 |  |
| 13 | Classification of Engineering Materials | CO2 | To understand the concept of types of diffenrent type of engineering materials, their mechanical properties and strengthing mechanism. | Classify various type of engineerng materials |
| 14 | Classification of Engineering Materials (Continue) | CO2 | Classify various type of engineerng materials |
| 15 | General principles of phase transformation | CO2 | Understand the basic concept of phase transformation |
| 16 | phase rule and equilibrium diagrams | CO2 | Understand the basic concept of phase rules and phase diagram |
| 17 | phase rule and equilibrium diagrams (Contunie ) | CO2 | Understand the concept of phase rules and phase diagram |
| 18 | phase rule and equilibrium diagrams (Contunie ) | CO2 | Understand the concept of phase rules and phase diagram |
| 19 | Iron carbon equilibrium diagram | CO3 | Acquaint with the fundamentals of phase diagram, phase transformation and thermal processing of metals | Understand the concept of iron carbon phase diagram . |
| 20 | Iron carbon equilibrium diagram (Contunie ) | CO3 | Understand the concept of iron carbon phase diagram . |
| 21 | Iron carbon equilibrium diagram (Contunie ) | CO3 | Understand the concept of iron carbon phase diagram . |
| 22 | Full annealing | CO3 | Understand the basic operation perform to improce mechanical properties |
| 23 | Normalizing, Hardening and Tempering of steel | CO3 | Understand the concept of annealling and hardning process. |
| 24 | Types of fracture | CO2 | Classify various type of fracture in materials |
| 25 | Case hardening | CO3 | Understand the concept of case hardning . |
| 26 | Carburising, | CO3 | Understand the concept of nitriding operation . |
| 27 | Nitriding | CO3 | Understand the concept of cynading and carbonitriding operation . |
| 28 | Cyaniding and Carbonitriding | CO3 |  |
| 29 | Non-Metallic Materials | CO4 | Acquaint with the various nonmetal materials such as polymers and composite | Classify various type of nonmetals materials |
| 30 | Types of polymer | CO4 | Classify various type polymer . |
| 31 | Properties and applications of polymers | CO4 | Understand the basic properties and application of polymers. |
| 32 | Properties and applications of polymers (Continue) | CO4 | Understand the properties and application of polymers. |
| 33 | Properties and applications of polymers (Continue) | CO4 | Understand the properties and application of polymers. |
| 34 | Types of composites materials | CO4 | Classify various type composite materilas . |
| 35 | Properties and applications of composite materials | CO4 | Understand the concept alloys . |
| 36 | Constitution of alloys | CO4 | Identify the effect of alloying . |
| 37 | Effect of alloying | CO4 | Understand the basic mechanical properties |
| 38 | Mechanical Properties and Testing | CO4 | Understand the various mechanical testing perfom under loads |
| 39 | Mechanical Testing of engineering materials under loads | CO4 | Understand the various mechanical testing perfom under loads |
| 40 | RTU Previous question papers |  |  |  |
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|  | **Name of Books** | | | **Author** |
|  | Materials Science and Engineering | | | V. Raghavan |
|  | Materials Science and Engineering: An Introduction | | | William D. Callister |
|  | Materials Science and Engineering: An Introduction | | | G.S NARULA |
|  | Materials Science and Engineering: An Introduction | | | R. K Rajput |