

LESSON PLAN

Fr. CRCE (Production)

Academic year: 2018-19

Fr. Conceicao Rodrigues College Of Engineering

Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50

Department of Production Engineering

S.E. (Production) (Semester III) (2018-2019)

Lecture Plan

Subject: Materials Science & Engineering (MSE)

Credits - 03

Module	Contents	Hrs
01	<p>1.1 Introduction to Materials Science and Engineering: Why study Materials Science and Engineering, Classification of materials, Processing-Structure-Properties-Performance Correlations. Types of atomic bonding – metallic, ionic and covalent (basics).</p> <p>1.2 Crystal imperfection: Definition, Classification, Point defects: their formation and effects. Dislocations: edge and screw dislocations, their significance. Surface defects: grain boundary, sub-angle grain boundary, stacking fault, and their significance. Dislocation generation by Frank Reed sources. Dislocation interactions.</p> <p>1.3 Deformation: Mechanisms of deformation; Critical resolved shear stress. Slip systems of FCC, BCC, HCP metals. Deformation in Single and Polycrystalline materials. Strain Hardening and its significance. Necessity of Process Annealing. Recovery, Recrystallization and Grain Growth; Factors affecting Recrystallization.</p>	07
02	<p>2.1 Fracture: Definition and types of fracture. Brittle fracture and Ductile fracture. Ductile-to-Brittle transition. Definition and significance (fundamental understanding only).</p> <p>2.2 Fatigue Failure: Definition of fatigue and significance of cyclic stress. Mechanism of fatigue. Fatigue testing. Test data presentation. S. N. Curve and its interpretation. Influence of important factors on fatigue.</p> <p>2.3 Creep: Definition and significance of creep. Effect of temperature and creep on mechanical behavior of materials. Creep testing and data presentation & analysis. Mechanism and types of creep.</p>	07
03	<p>3.1 Solidification of metals: Formation of solids from liquids of pure metals and alloys. Ingot defects and their remedies. Single crystal and polycrystalline materials. Anisotropy. Noncrystalline solids.</p> <p>3.2 Theory of Alloying: Significance of alloying: definition, classification and properties of different types of alloys.</p> <p>3.3 Alloy Phase Diagrams: Different types of alloy diagrams and their analysis. Tie bar and Lever rules and their application. Dispersion hardening/age hardening.</p> <p>3.4 The Iron-Iron Carbide Phase Diagram: Importance of Iron as engineering material, Allotropic forms of Iron. Iron-Iron carbide diagram and its analysis. Classification of Plain Carbon Steels and Cast Irons.</p>	08

LESSON PLAN

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04	<p>4.1 Principles of Heat treatment: Technology of heat treatment. Classification of heat treatment process. TTT Diagram. CCT Diagram and Superimposition of cooling curves on Diagram.</p> <p>4.2 Heat treatment Process: Annealing: Principle, process, and properties developed on Full Annealing; Spheroid zing; Process annealing, Stress relieve annealing. Normalizing: The process and its applications Hardening: Hardening media, Salt baths, Hardenability. Tempering, Subzero treatment, Austempering, Martempering, Maraging and Ausforming process. Surface hardening: Surface Hardening methods. Their significance and applications. Carburizing, Nitriding, Cyaniding, Carbon-nitriding. Induction hardening and Flame hardening processes.</p> <p>4.3 Heat treatment defects: Defect during heat treatment process. Typical design guidelines in Heat treatment.</p>	09
05	<p>5.1 Effect of Alloying Elements in Steels: Limitation of plain carbon steels. Significance of alloying elements. Effects of major and minor constituents, Effect of alloying elements on ferrite, carbide, austenite, Effect of alloying elements on phase transformation, decomposition, hardening and tempering. Tool steels: Important compositions and applications. Stainless steels : Important compositions and applications</p> <p>5.2 Non Ferrous Metals and their Alloys: Basic Treatment Only. Important non-ferrous materials like Aluminum, Copper, Nickel, Tin, and Zinc – Their alloys, properties and applications.</p>	06
06	<p>Introduction to New Materials: (Fundamental understanding only)</p> <p>6.1 Composites: Basic concepts of composites, advantages over metallic materials, various types of composites and their applications, Manufacturing Processes for Thermoset Composites – Hand Lay Up, Spray Up, Filament Winding, Pultrusion, Resin Transfer Molding, Structural Reaction Injection Molding, Compression Molding.</p> <p>6.2 Nano-structured materials: Introduction, Concepts, synthesis of nano materials, examples, applications and nano composites.</p> <p>6.3 Biomaterials: Introduction, examples and applications.</p> <p>6.4 Smart materials: Introduction, examples and applications.</p>	05

Co No.	Course Outcomes
CO1	Demonstrate the process of solidification of metals along with various types of crystal imperfections.
CO2	Distinguish between various modes of material failure.
CO3	Analyze various alloy phase diagrams including iron-iron carbide diagram.
CO4	Select proper heat treatment process for steel in order to attain desirable properties.
CO5	Describe the properties with application of alloy steels/non-ferrous metals.
CO6	Describe the properties with application of composites/nano structured materials.

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CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	2
CO2	3	3	2	-	-	-	-	-	-	-	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	3	-	-	-	-	-	-	3
CO5	3	3	3	-	-	-	-	-	-	-	-	3
CO6	3	3	3	-	-	-	-	-	-	-	-	3

Target = 2 for all COs

FINAL CO	=	(0.8* Direct) + (0.2* Indirect)
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Direct	CO1	(0.7*Test) +(0.3*Univ Exam)
	CO2	(0.7*Test) +(0.3*Univ Exam)
	CO3	(0.7*Test) +(0.3*Univ Exam)
	CO4	(0.7*Test) +(0.3*Univ Exam)
	CO5	(0.7*Test) +(0.3*Univ Exam)
	CO6	(0.7*Test) +(0.3*Univ Exam)

Indirect	CO1	(1*Exit Survey)
	CO2	(1*Exit Survey)
	CO3	(1*Exit Survey)
	CO4	(1*Exit Survey)
	CO5	(1*Exit Survey)
	CO6	(1*Exit Survey)

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LECTURE PLAN

Note: - Content beyond syllabus (CBS) is in **bold**

Weekly Plan	Actual Date	Lecture		Module	CO Mapping
		No	Topic		
1	02/07	1	Introduction to Materials Technology. Structure-Property relationship.	1.1	-
	04/07	2	Introduction to Metal, Ceramics, Polymers, Composites, Advanced materials. Biomaterials and Semiconductors. Types of Bonding.	1.1	-
	06/07	3	Smart Materials, Nanomaterials, Crystal imperfection–Vacancy & Interstitial.	1.2	CO1
2	10/07		Deluge		
	11/07	4	Substitution/Interstitial Solid Solution. Theory of alloying. Classification of alloys. Edge Dislocations.	1.2 3.2	CO1
	13/07	5	Screw and Mixed dislocations. Grain boundary and Stacking fault.	1.2	CO1
3	16/07	6	Frank-Reed Mechanism. Dislocation interaction. Deformation (Elastic and Plastic)	1.2 1.3	CO1
	18/07	7	Solidification of metals, Nucleation & Growth. Structure of Ingots and Casting.	3.1	CO1
	19/07	8	Ingot defects and remedies (Shrinkage, Porosity). Ingot defects and remedies (Gas porosity). Single & Polycrystals.	3.1	CO1
4	23/07		Non-instructional Day (TCS Workshop)		
	25/07	9	Noncrystalline material. Crystal structure (FCC, BCC, and HCP). Slip system – BCC, FCC, HCP. Critical Resolved Shear Stress. Deformation of Single crystal.	3.1 1.3	CO1
	26/07	10	Deformation of Polycrystals. Dislocation motion and Grain boundary. Strain hardening, Recovery.	3.1 1.3	CO1
5	30/07	11	Recrystallization, Grain Growth. Factors affecting the recrystallization temperature. Types of Fracture.	1.3 2.1	CO1 CO2
	01/07	12	Evolution to failure in ductile materials. Types of Brittle fracture, Ductile-to-brittle transition. Fatigue, Fatigue cycles.	2.1 2.2	CO2
	02/08	13	Fatigue testing, S-N curve, Stages of fatigue. Factors that affect fatigue life. Creep Effect of temperature on creep. Dislocation climb.	2.2 2.3	CO2
	04/08	14	Creep test. Creep curve. Alloy Phase Diagrams–Component, Phases.	2.3 3.3	CO2 CO3
6	06/08	15	Solubility limit. Effect of temperature & composition on the Alloy Phase Diagrams. Lever rule.	3.3	CO3
	08/08	16	Microstructure development. Binary Eutectic Phase diagram. Hypoeutectic and Hypereutectic composition. Formation of Eutectic structure. Eutectic reactions.	3.3	CO3
	09/08		Maharashtra Bandh		
7	13-		UNIT TEST – 1		

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	16/08				
8	21/08	17	Eutectoid and Peritectic reactions. (3.3) The Iron-Iron Carbide Phase Diagram. Allotrope of Iron. Hypoeutectoid and Hypereutectoid steel. Growth of eutectic pearlite. The Iron-Iron Carbide Phase Diagram.	3.4	CO3
	21/08	18	Hypoeutectoid & Hypereutectoid steel. Principles of Heat treatment – Definition,	3.4, 4.1	CO3 CO4
	22/08		Bakri Eid - Holiday		
	23/08	19	Time-Temperature-Transformation (TTT), Heat treatment curve superimposed on TTT diagram. Bainite. Gave seminar topic.	4.1 & 4.2	CO4
9	28/08	20	Martensite, Spheroidite, Continuous Cooling Curve (CCT)	4.2	CO4
	29/08	21	Annealing, Spheroidizing, Process annealing, Stress relieve annealing	4.2	CO4
	30/08	22	Normalizing, Hardening, Quenching, Tempering, Martempering, Austempering, Ausforming,	4.2	CO4
10	04/09	23	Maraging, Carburizing, Nitriding, Cyaniding, Flame & Induction Hardening. Heat treatment defects (Self Study). Effect of Alloying Elements in Steels (Self Study). Composites – Classifications, Particle-reinforced	4.2 6.1	CO4 CO6
	05/09	24	Fibers-reinforced composites. MMC, CMC & PMC. Composite manufacturing processes. Nanostructure Material (Self Study).	6.1	CO6
	06/09	25	Seminar 1 (Recycling plastics, Cast Iron – Their types, properties and application. Polymers synthesis and processing)	5.2	CO5
11	11/09	26	Seminar 2 (Shape Memory Alloys, <i>Hardness test – Types, Applications, Nanocarbons – Types, Structure and Applications</i>)	6.4	CO6
	12/09	27	Seminar 3 (Magnetostrictive materials, Copper – Their alloys, properties and applications, Aluminum – Their alloys, properties and applications)	5.2	CO5
	13/09		Anant Chaturdashi - Holiday Midterm Break - Holiday		-
12	18/09	28	Seminar 4 (Plywood, Piezoelectric Ceramic, Structure of wood)	<i>CBS</i>	-
	19/09	29	Seminar 5 (Photonic materials, Application and mechanism of Diffusion in solids, Mesoporous materials – Synthesis and Applications)	<i>CBS</i>	-
	20/09		Moharram - Holiday		-
13	25/09	30	Seminar 6 (Biomaterials, Kevlar, Semiconductors)	<i>CBS</i>	-
	26/09		Industrial Visit		
	27/09		Seminar 6 (Magnetic materials, LCD, Corrosion & Wear)	<i>CBS</i>	-
14	01/10		Remedial Classes		
	04/10		Remedial Classes		
15	10-12/10		UNIT TEST – 2		
16	16/10		Termwork Submission		