BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP/2023)

CLASS: B.Tech. **SEMESTER : VI**
BRANCH: PIE/MECH **SESSION : SP/2023**

SUBJECT: PE324 SURFACE ENGINEERING AND LASER ADDITIVE MANUFACTURING

TIME: 02 Hours **FULL MARKS: 100**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 20 marks and total 100 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	Differentiate between the following pairs of properties/processes which appear similar (in one/two lines using appropriate definition/diagram/equation): i) Resilience and toughness ii) Ductility and brittleness iii) Aqueous corrosion and oxidation iv) Grinding and polishing v) Wear and erosion	[5x2=10]	2	2
Q.1(b)	Differentiate between the following pairs just in one/two sentences: i. Hardness and hardenability ii. Crystal system and crystal lattice iii. Adsorption and absorption iv. Dislocation and vacancy v. Grain and phase boundary	[2x5=10]	2	4

Q.2(a) Select appropriate items from Column A and Column B to form a relevant pair in terms of process, property and/or characteristics: [1x10=10] CO 3 BL 4

Column A	Column B
i. Carburizing	a) Coating at supersonic velocity
ii. Oxidation of mild steel	b) Residual compressive stress
iii. Erosion	c) Molten Zn-Al metal bath
iv. Polishing	d) Martensite
v. Electro polishing	e) Spallation
vi. Face centered cubic	f) Molten aluminum bath
vii. HVOF coating	g) Damage by stream of particles/ fluid
viii. Galvanizing	h) Surface roughness
ix. Ultrasonic peening	i) Packing density of 74%
x. Hot dip coating	j) Oxidation at anode but reduction at cathode

Q.2(b) Name the most obvious/common mode of failure (or combination) for the following engineering members/components/machines: [1x10=10] CO 4 BL 1

i. Crankshaft of automobile
ii. Turbine blades of an aircraft engine
iii. Electrical spark plug
iv. Human knee joint (causing pain)
v. Circular saw for wood cutting
vi. Drill head for rock drilling
vii. Underground oil pipe line
viii. Boiler vessel tube
ix. Automobile brake shoe/pad
x. Link pins of bicycle chain

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Q.3(a)	Examine and correct the following statements by revising only the underlined word/phrase, wherever applicable: i. Residual compressive stress in shot peening is due to martensite ii. Rusting is common in corrosion of aluminium iii. Ion implantation is a non line-of-sight process iv. Localised corrosion in stainless steel due to chlorine ion is called erosion corrosion v. Silicon is an ideal semi-conduction due to overlapping band gap vi. Hardening of steel producing martensite is a diffusive transformation vii. Austenitic stainless steel contains both nickel and sulphur viii. Polymeric solids are mostly amorphous containing metallic bond ix. Solidification of a metal produces surface residual compressive stress x. Number of lattice parameters to uniquely define a unit cell is eight	[1x10=10]	1	4
Q.3(b)	Study the following questions and answer just in one word or phase: i. A polishing operation that does not apply abrasives: ii. The process by which average grain size of a brass plate can be reduced without melting: iii. A surface hardening method of steel that involves change in surface microstructure but no change in composition: iv. A binary phase diagram that shows complete solubility both in liquid and solid state: v. A common process of failure due to cyclic loading at room temperature: vi. An element suitable for alloying/coating for oxidation protection of steel: vii. An invariant reaction due to which a binary alloy melts at a temperature lower than melting point of either components: viii. Degree of freedom for melting of a ternary alloy at eutectoid point is: ix. Number of atoms per simple triclinic unit cell is: x. The two types of phase aggregates produced by eutectoid transformation in steel are:	[1x10=10]	1,2	1
Q.4(a)	(i) What is the essential difference between the core and surface of an engineering solid? (ii)Why ionic solids are usually stronger and more brittle than metallic alloys even if both contain dislocations? (iii)State any two possible methods by a pure metal can be strengthened without changing composition. (iv)Why is a metallic sheet opaque but the window glass is transparent to light? (v)Why fast cooling or quenching is essential for form martensite in steel?	[2x5=10]	1,2	2
Q.4(b)	(i) How does corrosion differ from leaching or dissolution? (ii) Cite two examples of corrosion degradation that amounts to substantial loss of material or money in industrial applications? (iii) Classify the major types of corrosion (only name them)? (iv) Name the major types of wear or abrasion damages. (v) How is eutectic change different than eutectoid change in a binary alloy?	[2x5=10]	2	2
Q.5(a)	Draw the following schematically (any TWO): i. A binary eutectic phase diagram ii. An edge dislocation iii. Interstitial and substitutional solute atoms in a lattice iv. A hexagonal unit cell	[5x2=10]	1	1
Q.5(b)	(i) Why any precipitate cannot provide precipitation hardening? (ii) Why is induction hardening effective only with steel > 0.4% C? (iii) Why should components subjected to carburizing contain < 0.2% C? (iv) What main parameters control effective case depth of carburized layer? (v) Why does hardness vary along depth from the surface in hardened steel?	[2x5=10]	3	2

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