

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: M. TECH/PRE-PHD
BRANCH: PIE

SEMESTER : II
SESSION : SP/2024

SUBJECT: PE530 MATERIALS FOR ENGINEERING APPLICATIONS

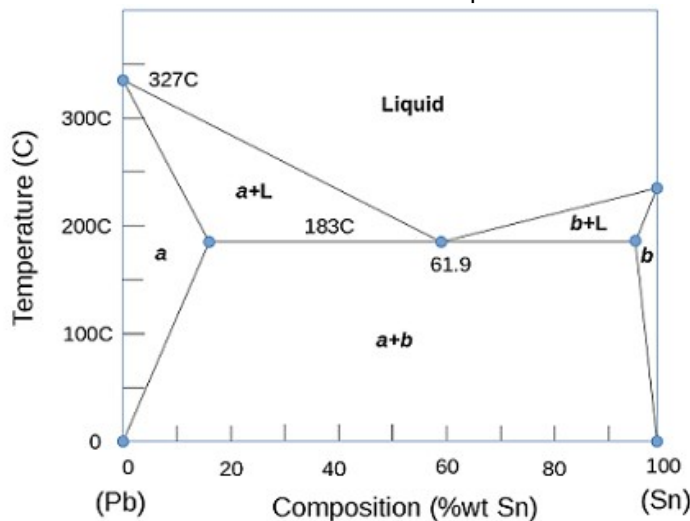
TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

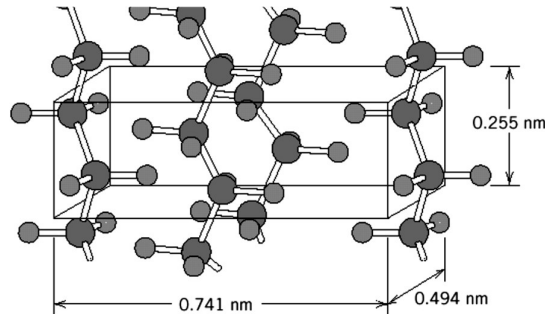
- Q.1(a) I. Discuss the paradigm shift in usage of materials for manufacturing automobiles parts over the last 30 years with a suitable justification. [2+3] CO CO1 BL BL4 BL3
- II. Determine the following for 40 wt.% Sn alloy at 150 °C:
A. The phases present and their compositions
B. The relative amount of each phase



- Q.1(b) I. With the help of a neat iron-cementite metastable phase diagram, explain the reasons behind the high strength of steels. [4+1] CO1 BL3 BL1
- II. List some applications of titanium alloys.
- Q.2(a) I. Define coordination number. [1+2] CO2 BL1 BL2 BL3
- II. In ceramics, show that the minimum cation-to-anion radius ratio for the coordination number 3 is 0.155.
- III. Based on the ionic radii of Al^{3+} (0.053 nm) and O^{2-} (0.140 nm), predict the coordination number, geometry, and crystal structure of Al_2O_3 .
- Q.2(b) I. Explain the mechanism of brittle fracture in ceramics. [2+2] CO2 BL2 BL1
- II. Tensile testing is not suitable for ceramics - Justify the statement with logical reasoning. +1
- III. List some applications of refractories.

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- Q.3(a) I. Describe the various covalent chain configurations in homo polymers with neat sketches stating the variation of strength for the different configurations. [2+3] CO3 BL2
BL3
- II. The orthorhombic unit cell for polyethylene is shown below; also, the equivalent of two ethylene repeat units is contained within each unit cell.
- (A) Compute the density of totally crystalline polyethylene.
- (B) Calculate the percent crystallinity of a branched polyethylene that has a density of 0.925 g/cm^3 . The density for the totally amorphous material is 0.870 g/cm^3 .



- Q.3(b) I. Differentiate between thermosets and thermoplastics. [2+3] CO3 BL2
- II. Discuss about the range of elastic module in particle reinforced composites.
- Q.4(a) A copper wire is 3 mm in diameter and 2 m in length [5] CO4 BL3
- I. Compute the resistance of the copper wire.
- II. Estimate the current flow if the potential drop across the ends of the wire is 0.05 V.
- III. Evaluate the current density.
- IV. Determine the magnitude of the electric field across the ends of the wire?
- [Conductivity of Cu = $6.0 \times 10^7 (\Omega\text{-m})^{-1}$]
- Q.4(b) I. Discuss in detail about MOSFET transistor. [2+3] CO4 BL2
- II. discuss the mechanism of information transfer through optical fibers.
- Q.5(a) I. Explain the increase in strength of nanomaterials in light of Hall Petch mechanism. [2+2+1] CO5 BL3
BL4
BL1
- II. The strength of nanomaterials ceases to increase beyond a certain limit - Justify this statement with proper reasoning.
- III. State some applications of nanofluids.
- Q.5(b) I. Discuss shape memory effect in detail. [3+2] CO5 BL2
BL1
- II. List some applications of HSLA steels and TRIP steels.