

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)

**DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING**

Final Semester Examination

Summer Semester, A.Y. 2021-2022

Course No. ME 4225

Time : 3 hours

Course Title: Material Engineering

Full Marks : 150

There are **06 (Six)** Questions. Answer all of them. Marks in the margin indicate full marks. Do not write on this question paper. Symbols carry their usual meanings. Assume reasonable values for any missing data. Programmable calculators are not allowed.

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- 1 Metals usually exhibit three different crystal structures of SC, BCC or FCC. Assess the statement that FCC metals are more ductile than BCC due to their higher packing density showing relevant calculation of their packing density. Explain how HCP structure differs from FCC and how it alters brittleness of the materials . 25  
(CO3, CO4)  
(PO3, PO4)
  - 2 Draw an isomorphous phase diagram and predict the solidification behavior of an alloy containing 50 wt.% of each component. List the information that can be obtained using a tie line and draw a tie line for the alloy in the two-phase zone to calculate those quantitative data. Also, draw the room temperature microstructure for the above alloy. 25  
(CO3, CO4)  
(PO3, PO4)
  - 3 Properties of polymers are highly controlled by their molecular structure which is further controlled by the synthesis route. Explain the two major synthesis routes to produce polymers with necessary examples. Argue the statement that molecular weight of polymers can be controlled precisely by controlling the amount of the reactants. 25  
(CO3, CO4)  
(PO3, PO4)
  - 4 Draw an Iron-iron carbon diagram and label it completely; also identify the compositions for hypo and hyper eutectoid steel. With neat sketches, distinguish between their room temperature microstructures. Rate these two types of steel considering their tensile strength and explain how to predict the strength from their microstructures. 25  
(CO3, CO4)  
(PO3, PO4)
  - 5 Heat treatment is essential to tune mechanical properties of steel. Comment on the purpose of annealing, normalizing and quenching processes mentioning their effect on the mechanical properties of the heat-treated steel products. Explain the above heat-treatment cycles briefly showing the resultant effect on the final microstructure. 25  
(CO3, CO4)  
(PO3, PO4)
  - 6 Composites are designed to combine materials with the objective of getting a more desirable combination of properties. Matrix plays a crucial role here. Rate the composites based on matrix types showing their advantages and disadvantages. If a composite is fabricated with aligned long fibers, explain how to predict young's modulus, E for the composite in both parallel and perpendicular directions to the fiber alignment direction. 25  
(CO3, CO4)  
(PO3, PO4)