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# S.E. (Mechanical/Automation & Robotics Engg.)
# ENGINEERING MATERIALS AND METALLURGY
## (2019 Pattern) (202044) (Semester - III)

*Time : 2½ Hours]*             *[Max. Marks : 70*

*Instructions to the candidates :*

1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right side indicate full marks.*
4) *Use of Logarithmic tables, slide rule, electronic pocket calculator is allowed.*
5) *Assume suitable data if necessary.*

*Q1)* a) Define the following with the help of a neat sketch. **[5]**

     i) Ordered Substitutional Solid Solution

     ii) Disordered Substitutional Solid Solution

   b) What is meant by a binary Solid Solution alloy, draw the cooling curve of a typical solid solution alloy. **[5]**

   c) What is a peritectic transformation? Show the peritectic point on Fe-C phase diagram. Evaluate the percentage of constituent elements at the peritectic point. **[8]**

### OR

*Q2)* a) Explain how the following factors affect the nucleation process and graph the effect as a function of temperature. **[5]**

     i) Nucleation Rate.

     ii) The Growth Rate

   b) What is Gibb's phase rule? Explain the various terms involved in it. **[5]**

   c) What is an Eutectoid transformation? Show the Eutectoid point on Fe-C phase diagram. Evaluate the percentage of constituent elements at the Eutectoid point. **[8]**

*P.T.O.*

*Q3)* a) State the difference between Martensite and Pearlite on the basis of the Following points. **[5]**

    i) Mechanism of formation

    ii) Microstructure

    iii) Cooling rate

    iv) Properties

    v) Application

   b) Give any two reasons why Hypereutectoid steels in an Iron-Carbon Alloy are annealed from above the lower critical temperature ($A_1$) but never from above the upper critical temperature ($A_{cm}$). **[5]**

   c) Describe the induction hardening technique and its two advantages and two disadvantages over flame hardening. **[7]**

<div align="center">OR</div>

*Q4)* a) What is retained austenite? Write any two advantages and one disadvantage of Retained austenite in hardened steel? **[5]**

   b) State the difference between Annealing and Normalizing with reference to the following points ? **[5]**

    i) Procedure

    ii) Microstructure

    iii) Mechanical properties imparted after the process

    iv) Internal Stresses

    v) Grain size distribution

   c) Show the following heat treatment cycles on a common Isothermal Transformation diagram of a hypoeutectoid steel. **[7]**

    i) Martempering

    ii) Austempering

   also state the reason why the Austempering processes is expensive?

*Q5)* a) What is the content of carbon in Low Carbon Steel? State two Properties and two applications of Low Carbon Steel. **[5]**

b) What type of stainless steel would you prefer for the following and Why? **[5]**

   i)    Razor Blades

   ii)   Wrist watches

c) Explain the manufacturing process of a Malleable Cast Iron with the help of a Time – Temperature plot. State any four applications of Malleable Cast Iron. **[8]**

**OR**

**Q6)** a) What is the content of carbon in High Carbon Steel? State two Properties and two applications of High Carbon Steel. **[5]**

b) State the composition of the following steels which are designated as per Indian standard Designation system. **[5]**

   i)   25 C5

   ii)   35 Mn 1 S 18

c) Explain the effect of the following factors on the microstructure and properties of Cast Iron. **[8]**

   i)    Amount of total phosphorous, silicon and the equivalent carbon due to the presence of them (phosphorous and silicon)

   ii)   Rapid cooling, Slow cooling

**Q7)** a) What is 85-5-5-5 bronze? State any three applications of it. **[5]**

b) What is the percentage of Zinc in Gilding metals? State any four uses of Gilding metals. **[5]**

c) What is Nickel's crystal structure? Give the composition, at least one property, and use of the Nickel Alloys listed below. **[7]**

   i)    Invar

   ii)   Inconel

**OR**

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*Q8)* a) What are bearing materials? Give the composition of the following bearing material. **[5]**

    i)     White Metal Alloys

    ii)    Copper-Lead Alloys

b) List any two materials that are commonly used in additive manufacturing. Also, for each of them, mention two areas of Application. **[5]**

c) What is Aluminium's crystal structure? Give the composition, at least one property and use of the Aluminium Alloys listed below. **[7]**

    i)     Y-Alloy

    ii)    Hinduminium

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