

**B.E. (Met.) Part-III 6<sup>th</sup> Semester Examination, 2012**  
**HEAT TREATMENT TECHNOLOGY (MT-605)**

Full Marks :70

Time: 3 hours

Answer question No. 1 and any FIVE from the rest  
Marks in the margin indicate full marks  
All parts of a question must be written at one place  
Give neat sketches wherever necessary

1. (a) State if the following statement(s) are True or False (any Six): [1 x 6]
- (i) Cu is an austenite stabilizer
  - (ii) Ferrite stabilizers lower the carbon content of eutectoid composition, but austenite stabilizers increase the carbon content of the same.
  - (iii) The specific heat of aluminium is more than steel
  - (iv) SG iron consists of graphite nodules in ferritic base
  - (v) Mo raises the austenizing temperature of steel
  - (vi)  $\alpha$ -brass consists of 60% Cu and 40% Zn by weight
  - (vii) The maximum solid solubility of Cu in Al is 4.5 wt. %.
  - (viii) Iron-constantan thermocouple can be used at higher temperature range than Copper-constantan thermocouple.
  - (ix) A metal with ASTM grain size no. 6 is finer than that having ASTM grain size no. 10.
- (b) Answer the following (No marks awarded for incomplete / partly correct answer) (any Seven): [2 x 7]
- (i) At what temperature  $\gamma$ -iron transforms to  $\beta$ -iron and what is the crystal structure of  $\beta$ -iron?
  - (ii) With the help of Iron-Cementite phase diagram identify the minimum temperature at which complete liquid phase can be formed and write the corresponding wt. % C.
  - (iii) Calculate the wt. % of ferrite in a steel containing 0.8 wt. % C at room temperature.
  - (iv) Identify the main alloying elements and their wt. % in 18:8 stainless steel.
  - (v) Name one thermocouple material which is more suitable for measurement of heat treatment furnace temperature in the range 700 -1000°C and another material for the range 1200 - 1400°C?
  - (vi) Name one stainless steel which shows magnetic property and one alloy steel (except stainless steel) which shows non-magnetic property.
  - (vii) What is critical cooling rate?
  - (viii) Define severity of quench.
  - (ix) What is the principle of optical pyrometer?
  - (x) Name the process that can improve the strength in hardened steels containing retained austenite by transforming the austenite to martensite.
2. (a) Differentiate between stress-relieving annealing and spheroidizing annealing.  
(b) In hypereutectoid steels normalizing is done above  $A_{cm}$  temperature, but annealing is done only above  $A_{c1}$  temperature. Give reasons.  
(c) Between TTT and CCT diagrams which one is more important and why? [5+2½+2½]
3. (a) Identify the media having the maximum and the minimum severity of quench.  
(b) What is the difference between hardness and hardenability of steels?  
(c) How hardenability of steel is influenced by its chemistry and prior austenite grain size? [2+2+(3x2)]
4. (a) Name the different stages of heat removal during quenching and compare their cooling rate.  
(b) List the important characteristics of quenchants which control their effectiveness.  
(c) Name the quenchant that shows inverse solubility. What is inverse solubility? [4+3+(1+2)]

5. (a) Among pack carburizing, liquid carburizing and gas carburizing which process requires lowest carburizing time? Why the time is lowest in this process? Why this process falls in the red category industry?  
(b) Briefly describe the different methods of case depth measurements in steels. [(1+2+2)+5]
6. Briefly discuss the cause(s) of the following heat treatment defects and their method(s) of prevention (any **Two**): [5x2]  
(a) Soft spots  
(b) Quench cracks  
(c) Distortion of size and shape.
7. Write technical notes on (any **Two**): [5x2]  
(a) Laser hardening process  
(b) Martempering  
(c) Austempered ductile iron.
8. (a) Briefly explain the precipitation hardening characteristics of Al – 4.5 wt.% Cu alloy.  
(b) What is the necessity of inspection of heat-treated products? [5+5]
9. Write a typical composition of the followings, corresponding heat treatment schedule and expected properties (any **Three**): [10]  
(a) Transformer steel  
(b) Valve steel  
(c) Standard Ni-hard cast iron  
(d) Maraging steel.
10. What is the composition of 18:4:1 High Speed Steel? How do you heat treat this steel? What is a burnt structure? How do you avoid it? [2+4+2+2]