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Total number of printed pages – 2

B. Tech  
PCMT 4201

**Third Semester Examination – 2013**  
**INTRODUCTION TO PHYSICAL METALLURGY**

**BRANCH : MME, MM**

**QUESTION CODE : C- 494**

**Full Marks – 70**

**Time : 3 Hours**

*Answer Question No. 1 which is compulsory and any **five** from the rest.  
The figures in the right-hand margin indicate marks.*

1. Fill up the blanks : 2×10
- (a) The stacking sequence in HCP and FCC structures are \_\_\_\_\_ and \_\_\_\_\_.
- (b) \_\_\_\_\_ atoms are there per square millimeter ( $\text{mm}^2$ ) on (100) planes of Fe.
- (c) \_\_\_\_\_ and \_\_\_\_\_ can be produced by the dislocation interaction.
- (d) Slip systems are specified by \_\_\_\_\_ and \_\_\_\_\_.
- (e) \_\_\_\_\_ degrees of freedom in a Cu-40% Ni alloy at  $1200^\circ\text{C}$ .
- (f) \_\_\_\_\_ weight% of ferrite and \_\_\_\_\_ weight% of cementite in pearlite is formed in a 0.77wt% C steel at  $726^\circ\text{C}$ .
- (g) \_\_\_\_\_ condition favors the formation of grey cast-iron.
- (h) Austenite possesses \_\_\_\_\_ number of octahedral and \_\_\_\_\_ number of tetrahedral voids.
- (i) The iron-cementite is \_\_\_\_\_ phase diagram, while iron-graphite is \_\_\_\_\_ phase diagram.
- (j)  $\text{Cu}_3\text{Al}_2$  is \_\_\_\_\_ phase in \_\_\_\_\_ alloy systems.
2. (a) What is Bravais lattice ? Discuss the different types of Bravais lattice with their lattice vector and inter-vector angle. 5

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- (b) A metal having a cubic structure has a density of  $8.96 \text{ g/cm}^3$ . An atomic weight of  $63.54 \text{ g/mole}$  and a lattice parameter is  $3.610 \text{ \AA}$ . One atom is associated with each lattice point. Determine the crystal structure of the metal and the packing factor of this metal. 5
3. (a) Define Miller indices. Sketch the following planes and directions within each cubic unit cell : (012), (211), [112], [101]. 5
- (b) An aluminum single crystal is oriented in tensile testing machine with [123] parallel to the tensile axis. It is known that slip will begin in Al when  $\tau_{\text{crss}}$  on (111)[110] reaches  $1.2 \text{ MPa}$ . Calculate, what will be the yield stress for this crystal ? 5
4. Sketch the slip systems of BCC and FCC cubic system with planes and directions within each cubic unit cell. What is annealing ? Describe what happens when a cold worked metal is annealed ? 10
5. (a) What is cast-iron.? Draw the schematic microstructure for the following, and clearly labelling every phase : Pearlitic malleable cast-iron, Ferritic nodular cast-iron and white cast-iron. 5
- (b) Draw the Pb-Sn phase diagram. Determine the amount of  $\beta$  that forms if a Pb-10% Sn alloy is cooled to  $0 \text{ }^\circ\text{C}$ . 5
6. (a) What is tempering ? Discuss the changes in structure and properties due to tempering of martensite. 5
- (b) Explain briefly the effect of the additions of 16 wt% Cr and 8 wt% Ni alloying element simultaneously and separately to iron. 5
7. (a) Draw the TTT diagram of eutectoid steel and discuss the transformation products obtained at different temperatures. 5
- (b) What is brass ? Explain the structure and properties of  $\alpha$  and  $\beta$  brass with their composition. 5
8. Write short notes on any **two** of the following. 5×2
- (a) Homogenous nucleation and heterogeneous nucleation
- (b) Edge dislocation and screw dislocation
- (c) Intermetallic compound and interstitial compound
- (d) TTT curve and CCT curve.