BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
B.E. 5TH SEMESTER (MET) FINAL EXAMINATIONS, NOVEMBER-DECEMBER 2012

Phase Transformation

(MT 501)

Full Marks: 70 **Time: 3 hrs**

Answer any SEVEN questions. Use SINGLE answer-script for answering of all questions.

1. (a) Discuss heat treatment schedule and associated microstructural changes for Al-4.5 wt. % Cu alloy.

(b) What is duplex-ageing treatment? Discuss its significance.

(c) Briefly outline the role of *quenched-in vacancies* in precipitation hardening.

[(2+3)+(1+2)+2]

2. (a) With justifications, state the condition of achieving optimum hardness for age-hardenable alloy.

(b) Discuss the design philosophy for minimization of precipitation coarsening with examples

[4+6]

3. (a) Derive the expression of r^* and ΔG^* from *free-energy* consideration for heterogeneous solidification.

(b) *Heterogeneous nucleation is equivalent to homogeneous nucleation, if solid makes only point contact with the mould wall* – justify the statement.

(c) What is *inoculant*? Explain the selection criteria of inoculants with examples.

[4+2+(1+3)]

4. (a) Discuss mechanism of *dendritic solidification*.

(b) What is *coring*? How does it occur? How can it be removed?

(c) Discuss the generation of typical *cast structure* with net sketches.

[3+(1+2+1)+3]

5. Explain the following:

(a) *Solidification requires some degree of supercooling to start but melting occurs without any superheating.*

(b) *Rate of solidification reaches maximum at an intermediate temperature*

(c) *Coherent spinodal appears at lower temperature than chemical spinodal.*

[3+4+3]

6. (a) Discuss the mechanism of formation of austenite in hypoeutectoid steel.

(b) Explain with a suitable diagram the factors on which formation of homogeneous austenite depends

(c) Distinguish between overheating and burning of steel.

[4+4+2]

7. (a) What are the effects of alloying elements on T-T-T Curves?

(b) Why T-T-T- curve takes the C shape?

(c) Discuss the Hull-Mehl model to illustrate the nucleation and growth of pearlite. How does it vary from smith Hillert concept?

[4+3+3]

8. (a) What are the effects of alloying elements on the growth of pearlite?

(b) Define inter-lamelllar spacing of pearlite. What are the apparent and true inter-lamelllar spacings? How does inter-lamellar spacing vary with transformation temperature?

(c) Differentiate between sorbite and troostite.

[3+4+3]

9. (a) What is bainite? Differentiate it from pearlite. Distinguish between upper-bainite and lower-bainite.

(b) Why bainitic transformation is referred as intermediate transformation?

(c) *Bainitic transformation does not go to completion.* -- Justify the statement.

[4+3+3]

10. (a) What is reversibility and martensitic transformation? Briefly discuss the isothermal transformation of martensite.

(b) Explain using a net sketch the temperature dependence of the martensitic transformation in the Indium thallium alloy.

(c) Explain with a net sketch the martempering operation.

[4+3+3]