

B.E. Metallurgical and Material Engineering Third Year Second Semester Exam 2017

Subject: SOLID STATE PHASE TRANSFORMATION PROCESSES

Time: 3 hours

Full Marks: 100

Question no. 1 is compulsory. Answer any two (2) questions from the rest. Answers must be brief and to the point. All parts of the same question must be answered contiguously.

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| 1 | Answer any seven (7) questions. | 7x7 |
| | (a) Two specimens of 0.1 wt % of plain carbon steel were heated to 950 °C and 975 °C for 1 hour. Then the specimens were quenched in iced water. Comment on the final microstructure and hardness of the two specimens. Substantiate. | |
| | (b) Why does quench crack form in steels? | |
| | (c) Why does hardenability increase with increase in carbon content of the steel considering identical geometry of the specimens? | |
| | (d) What is the philosophy of designing Interstitial Free (IF) Steels? How does this steel achieve the required strength? | |
| | (e) Why does tensile properties of IF steel vary along rolling direction, transverse direction and normal direction? | |
| | (f) What is meant by thermal stabilization and mechanical stabilization of austenite to martensite formation? Explain. | |
| | (g) Why does dual phase steel exhibit good work hardening ability? | |
| | (h) What is the typical annealing temperature of hyper-eutectoid steel? Why? | |
| 2 | (a) Describe the microstructural changes that take place during different stages of tempering of a 0.4 wt % plain carbon steel. What experimental technique will you recommend to detect the degree of tempering? | 7+2 |
| | (b) Distinguish between Martempering and Austempering. | 6 |
| | (c) What is secondary hardening of steel? Why does Maraging steel exhibit a good combination of strength and toughness? | 5+5 |
| 3 | (a) What is the purpose of post carburizing heat treatment? Describe the post carburizing heat treatment. Looking at the microstructure how would you differentiate a high carbon martensite from very low carbon martensite? | 3+7+
3 |
| | (b) What is critical cooling rate? What does it depend on? What are the advantages of Jominy end quench test over Grossman hardenability test? What is the reason for high hardness of nitride layer in comparison to that obtained after carburizing? | 3+3+
3+3 |

- 4 (a) Discuss austenite stabilisation during Bainite transformation. 7
- (b) What is transformation induced plasticity? Is it always beneficial? Discuss. 7
- (c) Describe a suitable technique to demonstrate that martensitic transformation is a shear transformation 5
- (d) Distinguish: upper bainite and lower bainite. 6