

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-III (NEW) EXAMINATION – SUMMER 2019

Subject Code: 2131904

Date: 07/06/2019

Subject Name: Material Science and Metallurgy

Time: 02:30 PM TO 05:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

MARKS

- Q.1**
- (a)** Answer the following questions. **07**
- 1) What is Embryo?
 - 2) What is strain hardening?
 - 3) Define austenite.
 - 4) Define critical cooling rate.
 - 5) Define phase.
 - 6) Mention any one etchant used for mild steel along with its chemical composition.
 - 7) Write basic composition of SS304 (Austenitic Stainless Steel).
- (b)** Explain homogeneous nucleation using concept of free energy change. **04**
- (c)** Calculate proportion of phases present in 0.2% carbon steel at room temperature using lever rule principle as per Fe-C equilibrium diagram. **03**
- Q.2**
- (a)** Draw Miller indices for planes (0 1 1), (1 0 0) and (1 1 1) and directions [0 1 1], [1 0 0] and [1 1 1] in a simple cubic crystal. **03**
- (b)** What is red hardness? Explain specific purpose of different alloying elements in 18-4-1 HSS tool steel. **04**
- (c)** What is pro-eutectoid ferrite? With neat sketch explain step by step solid state transformation of 0.4% carbon steel from single phase Austenitic temperature to room temperature under equilibrium condition. Also draw room temperature microstructure and label phases present in it. **07**

OR

- (c)** Write Eutectoid reaction for Fe-C binary alloy system. Calculate proportion of phases present in Pearlite. Also explain Austenite to Pearlite transformation process with neat sketch. **07**
- Q.3**
- (a)** Differentiate between deformation by slip and twinning. **03**

- (b) Enlist different methods of preparation of metal powders and discuss characteristics of metal powders used in powder metallurgy. **04**
- (c) Draw different heat treatment cooling rate on T-T-T diagram mentioning respective final microstructure for low carbon steel. Write characteristics of Martensite. **07**

OR

- Q.3** (a) Why grain boundary is considered as a crystalline imperfection? **03**
- (b) What is sintering? Why is sintering carried out in controlled-atmosphere furnace? **04**
- (c) What is the effect of carbon and other alloying elements on T-T-T diagram? Explain in detail with neat sketch. What is the importance of this phenomenon in welding of alloy steels? **07**
- Q.4** (a) Write typical composition and application of:
1) Cartridge Brass 2) Inconel **03**
- (b) Why normalizing produces structure having superior strength and hardness compared to annealing? **04**
- (c) Explain mechanical properties and applications of Gray Cast Iron. **07**

OR

- Q.4** (a) What are the outstanding properties of cupronickel alloys? **03**
- (b) Write purpose of the case hardening heat treatment and explain any one in detail. **04**
- (c) Write short note on Malleable Cast Iron and Nodular Cast Iron. **07**
- Q.5** (a) What informations may be obtained from an equilibrium diagram? **03**
- (b) Explain various criterions for selection of material for engineering application. **04**
- (c) Explain working principle of Eddy Current Test. Mention various applications of Eddy Current Test. **07**

OR

- Q.5** (a) Write limitations of RT and UT. **03**
- (b) Explain various methods of magnetization used in MPT. **04**
- (c) Calculate density of copper crystal using following data. Atomic Radius of copper is $1.278 \text{ \AA}$, Atomic weight of copper is 63.5 gm/mol. Take Avogadro's number = 6.023×10^{23} . **07**
