Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course: Material Science (GNEG 232) **Semester: IV**
Program: B.Tech ADE+ET-IPR
Time: 03 hrs **Max. Marks: 100**

Instructions: Choice in Q 7 and internal choices in Q 10 and 11.

SECTION A

S. No.		Marks	CO
Q 1	Sketch following planes/directions in a cubic crystal: (110), (111), (100), [001], [010] planes.	4	CO1
Q 2	Draw a schematic stress-stress curve for a ductile material and show how to calculate resilience and toughness from this diagram.	4	CO3
Q 3	Discuss the effect of temperature on diffusivity.	4	CO1
Q 4	Describe various load cycles that can lead to fatigue failure.	4	CO3
Q 5	Discuss the effect of grain size on the strength of a polycrystalline material.	4	CO3

SECTION B

Q 6	Consider gas carburizing of gear steel at 927°C. Calculate carbon content at 0.5 mm beneath the surface of gear after 5 hrs carburizing time. Assume the carbon content at surface of gear is 0.90 % and the steel has a nominal carbon content of 0.2 %. z: 0.5, erf(z): 0.5205 z: 0.55, erf(z): 0.5633	10	CO4
Q 7	A hypothetical A–B alloy of composition 40 wt% B–60 wt% A at some temperature is found to consist of mass fractions of 0.66 and 0.34 for the α and β phases, respectively. If the composition of the α phase is 13 wt% B–87 wt% A, what is the composition of the phase? **OR** For alloys of two hypothetical metals A and B, there exist an α, A-rich phase and a β, B-rich phase. From the mass fractions of both phases for two different alloys provided in the table below, (which are at the same temperature), determine the composition of the phase boundary (or solubility limit) for both α and β phases at this temperature.	10	CO2
Q 8	For a nucleation and growth phase transformation, with the help of a graph, show how the free energy of a nucleus varies as a function of its radius. Also derive an expression for critical radii as a function of free energy and surface energy.	10	CO2

Q 9	Define hardenability. How is it measured? Explain with the help of Jominy-end quench test.	**10**	**CO3**
	SECTION-C		
Q 10	A. Sketch a completely labelled TTT curve for plain carbon eutectoid steel. B. Answer any two of the following: i) What is the crystal structure of Martensite phase? Discuss the factors that promote martensitic transformation in plain carbon steels. ii) What is critical cooling rate? Show how it is measured from TTT diagram. iii) Differentiate between Annealing and Normalizing. Also represent each of these heat treatment on TTT diagram	**10** **5+5**	**CO2**
Q 11	A. Sketch a completely labelled Fe-C (Iron-Carbon) phase diagram. B. Answer any two of the following: i) Discuss the microstructure development in a hypo-eutectoid steel as it is cooled from 900 ^{o}C to room temperature. ii) Discuss the microstructure development in a hyper-eutectoid steel as it is cooled from 900 ^{o}C to room temperature. iii) Discuss the difference between white cast iron and grey cast iron. Also write one application of each.	**10** **5+5**	**CO4**