

Name:	 UPES UNIVERSITY WITH A PURPOSE
Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2020

Course: Material Science	Semester: III
Program: B. Tech Mechatronics	Time 03 hrs.
Course Code: MEMA 2001	Max. Marks: 100

Instructions:

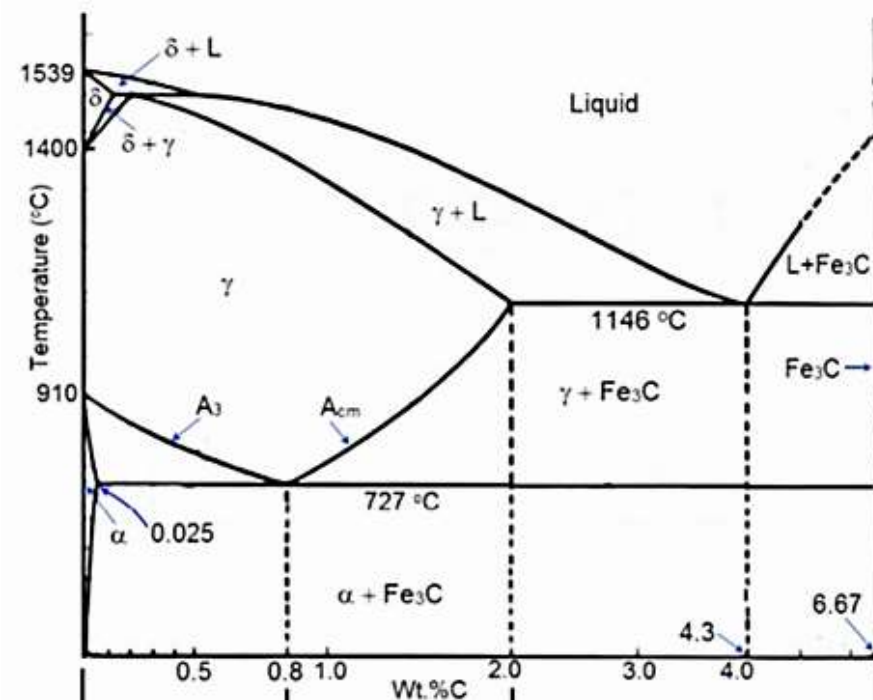
SECTION A: 5 marks each

S. No.		Marks	CO
Q 1	Write true or false: (i) Tempered martensite has better ductility than martensite. (ii) When steel with exactly 0.8% carbon by weight is cooled, the FCC structure of the mixture tries to revert back to its BCC structure. (iii) Monel is alloy of Nickel. (iv) Talc is not a ceramic. (v) Aluminium has fcc crystal structure.	5	CO1
Q 2	Microstructure of nodular cast iron consists of mixture of _____ and _____ while gray cast iron is composed of _____ and _____. Carbon range in cast irons is _____.	5	CO1
Q 3	(a) Amount of carbon in low carbon, medium carbon and high carbon steels respectively is _____, _____ and _____. (b) Carbon steels have _____ amount of alloying elements (low/high). (c) Stainless steels have _____ as an important alloying element for corrosion protection.	5	CO1
Q 4	Creep failure is _____.	5	CO2
Q 5	Important properties of abrasives that are required are _____ and _____. Abrasives can be used in _____, _____ and _____ forms.	5	CO1
Q 6	(i) For single component system when degree of freedom is '1' then number of phases are: (a) 0 (b) 1 (c) 2 (d) 3 (ii) At what temperature Fe turns paramagnetic while heating (a) 727 °C (b) 623 °C (c) 1146 °C (d) 1500 °C (iii) Phenomenon involved in phase transformation: (a) Nucleation (b) Growth (c) both a and b (d) none of these (iv) _____ is not a non-ferrous metal. (a) Aluminium (b) Zinc (c) Lead (d) Iron (v) _____ is alloyed with silver to make sterling silver. (a) Iron (b) Copper (c) Tin (d) Magnesium	5	CO1

SECTION B: 10 marks each

Q 7	Sketch neat and labelled crystal structure of Martensite and describe the process of structural evolution during rapid cooling.	10	CO5
Q 8	Sketch completely labelled stress vs strain curve for ductile and brittle materials and name the testing technique used to obtain these curves.	10	CO2
Q 9	Define fatigue failure. Neatly sketch the various fatigue loading cycles.	10	CO2
Q 10	Sketch and explain the microstructure evolution of eutectoid steel at 727 °C.	10	CO5

- Q 11
- A. Analyze the figure and answer the following questions:
- Write the solubility of carbon in ferrite at 727 °C.
 - At what temperature solubility in austenite phase is maximum. Write the solubility amount.
 - Write the name of eutectoid product.
 - Write eutectoid, eutectic and peritectic temperatures.
 - Write all the invariant reactions in this diagram.



**1+2+1
+3+3**

CO3

SECTION-C: 20 marks (Attempt either 12A or 12B)

Q 12	<p>A.</p> <ol style="list-style-type: none"> Sketch neat and completely labelled TTT curve. Discuss the effect of cooling rate on grain size using example of various microstructures formed during heat treatments. Using Hall-Petch equation, discuss the effect of grain size on strength. 	6	CO4
		8	
		6	

OR

	B. (i) Describe annealing, normalizing and quenching processes. (ii) Discuss Cyaniding and nitriding processes. (iii) Under what necessary cooling conditions, martensite forms.	12 6 2	
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