Name: **Enrolment No:**	UPES

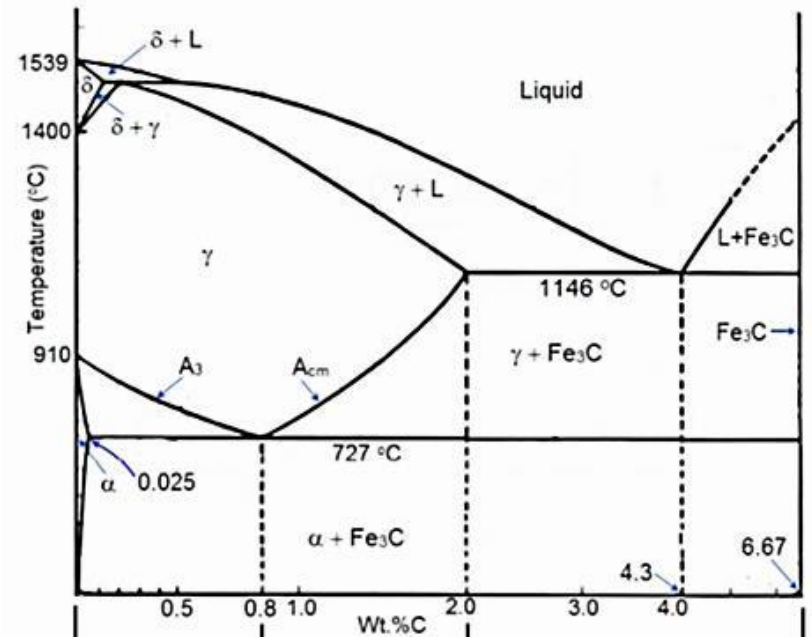
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, November 2021

Programme Name: B. Tech- Mechatronics **Semester : III**
Course Name : Material Science **Time : 03 hrs.**
Course Code : MEMA2001 **Max. Marks : 100**
Nos. of page(s) : 2

Instructions: Attempt All Questions. One question from section B and C have an internal Choice. Assume any Missing Data if required.

SECTION A

S. No.		Marks	CO
Q1	Explain crystal imperfections.	**4**	**CO1**
Q2	(a) Draw neat sketch of S-N curve for mild steel. (b) Define Vickers Hardness.	**2** **2**	**CO1**
Q3	Explain brittle and ductile fracture with appropriate examples.	**4**	**CO2**
Q4	Explain the phase transformation in solid state.	**4**	**CO3**
Q5	Classify the different steels.	**4**	**CO4**
	SECTION B		
Q6	(a) Draw a neat sketch of FCC crystal structure and calculate its packing factor, coordinate number. (b) Distinguish between Screw and Edge dislocation. (c) Define Burger's vector.	**5** **2.5** **2.5**	**CO1**
Q7	(a) Explain different types of phase diagram. (b) Define invariant reactions in phase Diagram with an example.	**5** **5**	**CO2**
Q8	Describe gray cast iron and nodular cast iron. Write their properties and applications.	**10**	**CO3**
Q9	A (i) Define fatigue failure. Neatly sketch the various fatigue loading cycles. (ii) What is Low cycle fatigue? Explain the method to estimate the fatigue damage in metals. Or B (i) Explain Griffith theory of brittle fracture. (ii) Explain with neat sketches the two modes of fracture failure of metal.	**5** **5** **5** **5**	**CO2**
	SECTION-C		
Q10	**A.** Analyze the figure and answer the following questions: (i) Write the solubility of carbon in ferrite at 727 ℃.	**1**	**CO4**

	(ii) At what temperature solubility in austenite phase is maximum. (iii) Write the name of eutectoid product. (iv) Write eutectoid, eutectic and peritectic temperatures. (v) Write all the invariant reactions in this diagram.  **B.** Sketch and explain the microstructure evolution of eutectoid steel at 727 °C.	**1** **1** **3** **6** **8**	
Q11	**A.** (i) Sketch neat and completely labelled TTT curve. (ii) Discuss the effect of cooling rate on grain size using example of various microstructures formed during heat treatments. (iii) Explain various methods of Hardening steels Or **B.** (i) Describe annealing, normalizing and quenching processes. (ii) Discuss Cyaniding and nitriding processes. (iii) Under what necessary cooling conditions, martensite forms.	 **6** **8** **6** **12** **6** **2**	**CO3**