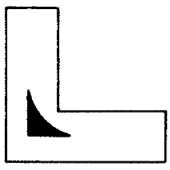
Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

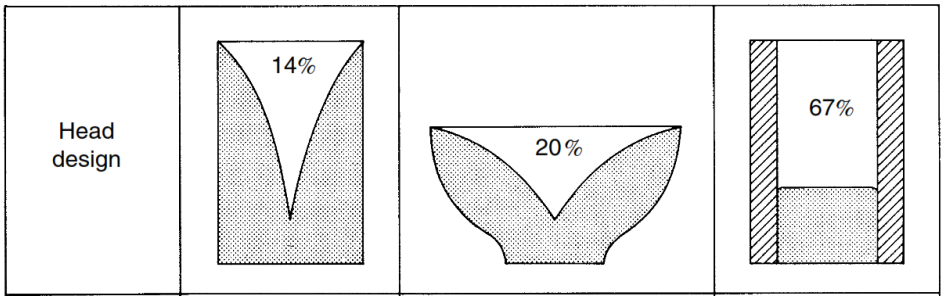
Course: Foundry Technology & Powder Metallurgy (MTEG 434) **Semester: VIII**
Programme: B. Tech MSNT
Time: 03 hrs **Max. Marks: 100**
Instructions: Choice in Q 5&8. Internal choice in Q 9&10.

SECTION A – 20 marks

S. No.		Marks	CO
Q 1	List two advantages and two limitations of powder metallurgy over other manufacturing processes.	**5**	
Q 2	Grinding and milling is one of the methods used for making metal powders, but these methods cannot produce uniform particle size or shape. Why?	**5**	
Q 3	With the help of a mathematical expression, define heat diffusivity of the mould material.	**5**	
Q 4	Why are chills used in a casting process? Figure below shows an L-section that is to be casted. Show the location where a chill would be placed to make a sound casting. 	**5**	

SECTION B – 40 marks

Q 5	**<u>Answer any TWO of the following:</u>** a) Calculate the casting modulus (considering the end-effect also) of a solid cylinder with diameter = 8 cm and length = 30 cm b) Write the mathematical expression for Chworinov's Rule and draw a schematic graph between log(t) and log(M) where t is time required for solidification and M is casting modulus. c) Calculate the horizontal velocity with which the molten metal would enter the cavity given the sprue height is 10 cm. Ignore any friction between molten metal and would walls.	**5+5**	
Q 6	a) Discuss the process used for manufacturing tungsten powder. b) Describe the process of creating tungsten carbide powder from the tungsten	**6+4**	

	powder obtained from above process?		
Q 7	Describe the Metal Injection Moulding (MIM) process used for making powder metallurgy products.	**10**	
Q 8	Briefly describe **any TWO** of the following processes used for atomization of molten metal to create powders: Water atomization, Gas atomization, Vacuum atomization, Centrifugal atomization	**5+5**	
	SECTION C – 40 marks		
Q 9	a) Draw a schematic sintering diagram (Ashby's diagram) and show regions corresponding to adhesion, grain boundary diffusion, surface diffusion and volume diffusion. **<u>Answer any TWO of the following:</u>** b) Briefly elaborate the various material transport mechanisms that are involved in sintering process. c) The driving force for sintering process is the reduction in free energy of the system. Which processes are responsible for this free energy reduction? d) Name the process and material variables that affect the sintering process.	**10** **5+5**	
Q 10	a) Draw the schematic of grain structure obtained after casting of a binary alloy which exhibits constitutional supercooling. Assume the cavity shape to be a cube. **<u>Answer any TWO of the following:</u>** b) The figure below shows three different feeder head designs – cylindrical head, hemispherical head and cylindrical head (with exothermic sleeve). The volume of shrinkage cavity is given for each head as a percentage of total head volume – 14%, 20% and 67%. For a casting of dimensions 100 mm x 50 mm x 25 mm, calculate the minimum riser volume required for each head design. Assume specific shrinkage of the alloy as 4%. 	**4** **8+8**	

	c) A casting of dimensions100 mm× 100 mm × 50 mm is required. Assume volume shrinkage of casting as 2.6%. A cylindrical riser is to be used for this casting. If the height of the riser is 80 mm and the riser volume desired is 4 times the shrinkage in casting, calculate the minimum riser diameter required. d) In a sand-casting operation, the total liquid head is maintained constant such that it is equal to the mould height. The time taken to fill the mould with a top gate is 5 minutes. Ignoring the time required to fill the runner and frictional effects, calculate the time required for filling the mould if a bottom gate is used.		