Course Code: SOE-B-MME603

O P JINDAL UNIVERSITY

B. Tech. VI Semester Backlog Examination

TRANSPORT PHENOMENA IN METALLURGICAL PROCESS

Time: 3 Hrs. **Max. Marks: 100**

Answer any one question from each unit

All questions carry equal marks

			M	CO	KL
Section-A					
1	a.	Define Biot number? Mention X and Y axis of Heisler charts.	2	01	01
	b.	Explain Fourier law of heat conduction and mention its mathematical expression?	2	01	01
	c.	What is meant by Newtonian heating or cooling?	2	01	01
	d.	What is meant by forced convection and derive the dimensions for thermal conductivity (K) Interms of fundamental quantities.	2	01	01
	e.	Define the terms (i) Emissivity (ii) Black body	2	01	01
	f.	Define thermal diffusivity and mention poison's equation.	2	01	01
	g.	Mention the dimensions for various variables: coefficient of thermal expansion, fluid heat capacity, Fluid viscosity and density.	2	01	01
	h.	Define Radiosity and total emissive power.	2	01	01
	i.	What is steady and unsteady flow?	2	01	01
	j.	How can we differentiate weather the flow is laminar or turbulent based on Reynolds number?	2	01	01
Section-B: **Unit-I**					
2	a.	What is compressible and incompressible flow? What are Newtonian and non-Newtonian fluids? What is steady and unsteady flow? Mention the continuity equation for steady flow and if the flow is incompressible in 3 dimension.	8	01	02
	b.	Define the statement of Bernoulli's equation. What is meant by $P/\rho g$, $V^2/2g$ and Z in Bernoulli's equation. Differentiate between Ideal and real fluids.	8	01	02
OR					
3	a.	A horizontal Venturimeter with inlet diameter 30cm and throat diameter 15 cm is used to measure the flow of water. Reading of differential manometer is 20 cm of Hg. Determine the rate of flow. **Given:** Specific gravity for Hg = 13.6, and water $S_0 = 1$, coefficient of discharge = 0.98.	8	03	03
	b.	Derive the expression for velocity of fluid in Pitot tube using Bernoulli's equation	8	02	05
Unit-II					
4	a.	Define conduction? Define thermal diffusivity? Explain Fourier law of heat conduction and mention its assumptions.	8	01	01
	b.	Derive the expression for heat conduction in Cartesian coordinates.	8	01	05

		OR			
5	a.	Derive an expression for heat conduction through plane wall.	8	02	05
	b.	The outer surface of a 0.15-m-thick refractory brick is at a temperature of 25°C, while the inner surface is kept at 415°C. The thermal conductivity of the refractory brick is 0.12 W/(mK). Determine the heat loss through the refractory brick of 10 m long and 3 m high.	8	03	03
		Unit-III			
6	a.	Differentiate between natural and forced convection? Air at atmospheric pressure and 200°C flow over a plate velocity of 5 m/s. The plate is 15 mm wide and is maintained at a temperature of 120°C. Calculate the thickness of hydrodynamics and thermal boundary layer and the local heat transfer coefficient at a distance of 0.5m from the leading edge. Assume that flow is on one side of the plate. $\rho = 0.815$ kg/m^3, $\mu = 24.5 \times 10^{-6}$ Ns/m^2, $P_r = 0.7$, k = 0.0364 w/m.k, u = 5 m/s, x = 0.5 m.	8	01	01
	b.	What is Buckingham's π theorem? Explain the procedure to be followed to form π terms.	8	02	01
		OR			
7	a.	A vertical cylinder 1.5m height and 180 mm in dia is maintained at 100°C in an atmospheric environment of 20°C. Calculate heat loss by free convection from the surface of the cylinder. Assume properties of air at mean temperature as ρ = 1.06 kg/m3 , $\vartheta = 18.97 \times 10^{-6}$ m2/sec, Cp = 1.004 kj/kg°C and k = 0.1042 kj/mh°C.	8	03	03
	b.	Define Reynolds number, Prandtl number, Nusselt number, Grashof number & Mention the dimensions of heat transfer coefficient.	8	01	01
		Unit-IV			
8	a.	Define: Absorptivity, Reflectivity and Transmissivity. Mention the emissivity value for white and gray body.	8	01	01
	b.	What is meant by shape factor? Mention the shape factor for hemispherical surface. A refractory material which has $\varepsilon = 0.4$ at 1500 K and $\varepsilon = 0.43$ at 1420 K is exposed to black furnace walls at 1500 K. what is the rate of gain of heat radiation per m^2 area. ($\sigma = 5.67 \times 10^{-8}$).	8	03	03
		OR			
9	a.	State Stefan Boltzmann law and also explain what is meant by opaque body?? Give the expression of reciprocating theorem? Also, mention the shape factor for flat surface and parallel plates.	8	01	01
	b.	Prove $\epsilon = \alpha$	8	01	03
		UNIT-V			
10	a.	A steel plate of 20 mm thickness and 1 m^2 surface area is quenched from a temperature of 800°C in water at 30°C. Calculate the time required to obtain the	8	03	03

		mid-point temperature of 400°C. Given: h = 60 $Wm^{-2}K^{-1}$, k = 30 $Wm^{-2}K^{-1}$, α = 0.023 $m^2 h^{-1}$, N_{Fo} = 37.			
	b.	Calculate the diffusion coefficient of "C" in α-iron at 500°C from the following data: Lattice constant of iron = 2.85 A°, inelastic strain relaxation time (τ_σ) = 4.7 x 10^{-10}s Also, calculate (i) the activation energy ΔH, and frequency factor D_o for the diffusion if the value of τ_σ changes to 4.28 x 10^{-8} s at 300°C, and (ii) the mean time of stay of a carbon atom at an interstitial site. Neglect the effect of change in lattice parameter caused by temperature variation.	8	03	03
		OR			
11	a.	Calculate the rising velocity of a 1.5 μm dia slag particle, rising through stagnant liquid steel at 1873K, given density of deoxidation product is 3000 kg/m^3, the density of liquid steel is 7600 kg/m^3 and viscosity is 7 CP. (Given g = 9.81 m/s^2)	8	03	03
	b.	In a laboratory experiment on the study of the mechanism of roasting of sulphide ores, pellets of ores of radius 1.5 cm were heated at 900 °C in an atmosphere of hot air. Calculate the rate of heat transfer by conduction inside the pellet. The thermal conductivity of the ore may be taken as 2W/mK and the initial surface temperature of the ore as 25 °C.	8	03	03

****

13/01/23

06

Course Code: SOE-B-MME605(1)

O P JINDAL UNIVERSITY

B. Tech. VI Semester Backlog Examinations

ADVANCED MATERIALS AND PROCESSES

(Offered to METALLURGY)

Time: 3 Hrs. **Max. Marks: 100**

Answer any one question from each unit

All questions carry equal marks

			M	CO	KL
Section-A: Answer all questions					
1	a.	Define crystal structure and Bravais lattice.	2	1	1
	b.	Define hall-petch relation for nanomaterials.	2	1	2
	c.	What is a dislocation? How many types of dislocations occur in materials?	2	1	1
	d.	Give main properties of nickel base superalloy.	2	2	2
	e.	What is covalent bonding? Give two examples.	2	1	1
	f.	Define diode? Write two applications.	2	1	1
	g.	What is Harper – Dorn creep?	2	3	2
	h.	What is shape memory alloy? Give its properties.	2	2	1
	i.	What are the two threats of Nanotechnology?	2	4	1
	j.	What are metal matrix composites?	2	2	1
Section-B: **Answer any one question from each unit**					
Unit-I					
2	a.	Explain the Bohr's atomic model in detail.	8	3	2
	b.	What is a defect? How it is related with strength in material?	8	3	2
OR					
3	a.	What are disorder phase transformations? Explain in detail.	8	3	2
	b.	What is the use of deformation mechanism maps. Explain its role in understanding the material performance.	8	2	2
Unit-II					
4	a.	What are foams? Explain its nature and properties in details.	8	1	2
	b.	What is Mechanical Alloying? Draw brief flowchart of the Mechanical alloying process.	8	2	2
OR					
5	a.	What are microstructure of gamma-titanium aluminides? Give their applications.	8	3	2
	b.	Explain the Monkman-Grant relationship for creep. Give its importance in understand the high temperature properties of materials.	8	3	2
Unit-III					
6	a.	What are low-dielectric constant materials. Explain their properties and applications.	8	2	2

	b.	Explain the properties of shape memory alloys.	8	3	2
		OR			
7	a.	What are the optoelectronic devices? Which materials are used and why?	8	2	2
	b.	What is the difference between soft and hard magnets? Explain their properties.	8	2	2
		Unit-IV			
8	a.	What are the advantages and limitations of nanotechnology?	8	4	2
	b.	How is the rapid solidification different from other accelerating techniques. Explain in detail.	8	3	2
		OR			
9	a.	At nano levels the thermodynamics is different. How?	8	4	3
	b.	How is nano tube or nanowire made. Explain their properties and applications.	8	4	3
		UNIT-V			
10	a.	Define sintering. Explain its benefits in powder metallurgy.	8	2	2
	b.	How is additive manufacturing different from conventional manufacturing methods?	8	3	3
		OR			
11	a.	Explain the properties and applications of polymer matrix composites.	8	2	2
	b.	Define reinforcement. Explain the various types of reinforcements in composite materials.	8	4	2