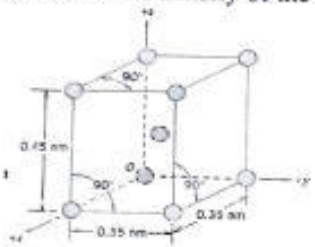
Engineering Materials
BE (Chem), 3rd semester

Time Allowed: 1.5 hours **Max. Marks: 25**

Q No	Problem statement	CO	Marks
I	i. A metal crystallizes in BCC structure. Calculate the lattice constant, given that the atomic weight and density for the metal are 6.94 and 530 kg/m³ respectively. ii. Sketch the following in a cubic unit cell (each in a separate unit cell): (001), (211), $[\bar{1}11]$, $(1\bar{2}0)$, (301), [011]	CO 1	1.5×2
II	The accompanying figure shows a unit cell for a hypothetical metal. (a) To which crystal system does this unit cell belong? (b) What would this crystal structure be called? (c) Calculate the density of the material, given that its atomic weight is 141 g/mol. 	CO 1	3
III	In FCC crystal structure, interstitial site is located at the centre of each edge. Identify the interstitial site. Compute the radius *r* of an impurity atom that will just fit into one of these sites in terms of the atomic radius *R* of the host atom.	CO 1	3
IV	Suppose that $CaCl_2$ is added as an impurity to CaO. If the Cl^- substitutes for O^{2-}, what kind of vacancies would you expect to form? How many of the vacancies are created for every Cl^- added?	CO 2	3
V	Calculate the number of vacancies per cubic meter at 1000°C for a metal that has an energy for vacancy formation of 1.22 eV/atom, a density of 6.25 g/cm³, and an atomic weight of 37.4 g/mol. Given k=8.62×10⁻⁵ eV/K	CO 2	3
VI	Atomic radius, crystal structure, electronegativity, and the most common valence are tabulated in the following table for several elements; for those that are nonmetals, only atomic radii are indicated. Which of these elements would you expect to form the following with copper: (a) A substitutional solid solution having complete solubility (b) A substitutional solid solution of incomplete solubility (c) An interstitial solid solution	CO 2	3
VII	Differentiate between (draw neat sketches, wherever required): i. Twin and a twin boundary ii. Low angle and a high angle grain boundary Would you expect the grain boundary energy of a small-angle grain boundary greater than, the same as, or less than for a high-angle one? Why?	CO2	3
VIII	The surface of 0.24 wt% C steel is to be strengthened by carburizing. The steel is placed in an atmosphere that provides a maximum of 1.2 wt %C at the surface of the steel. It is desirable that steel must contain 0.6% C at a depth of 1 mm below the surface. How long will carburizing take if the diffusion coefficient is 2.98×10^{-11} m²/s? The following data can be used:	CO2	4

Element	Atomic Radius (nm)	Crystal Structure	Electronegativity	Valence
Cu	0.1278	FCC	1.9	+2
H	0.046			
O	0.060			
Ag	0.1445	FCC	1.9	+1
Al	0.1431	FCC	1.5	+3
Ni	0.1246	FCC	1.8	+2
Zn	0.1332	HCP	1.6	+2

z	0.4	0.45	0.5	0.55	0.6	0.65	0.7
erf (z)	0.4284	0.4755	0.5205	0.5633	0.6039	0.6420	0.6778

23145

Dr SSB UICET

Peroidical:2nd

Subject: PED Lab Class: B.E(Chem.)-2nd Year M. Marks: 25 Date: 20/11/2024

Q.1 1*5=5

(a) if the thin cylindrical shell whose diameter is 'd' subjected to an internal pressure'. then the ratio of the longitudinal stress to hoop stress is...

(b) List five applications of external pressure vessels.

(c) Define joint. List the types.

(d) List the names of the Five standard governing organisations of different countries with full names.

(e) List the type of heads for pressure vessels.

Q.2 A process vessel is to be designed for a maximum operating pressure(abs) of 501 kN/m^2. An understanding between the purchaser and manufacturer indicates that the vessel should be over-designed considering 6^ extra to maximum working stress. The vessel has an outer diameter of 1.5m. The vessel is made 2002-1962 grade 2A and its designed temperature is 435 °C. A corrosion allowance of 2mm is suggested for the expected life of the vessel. It is fabricated according to either class 1 and class 2 of Indian standard specifications where a single welded butt joint with a backing strip is used. What will be the standard plate thickness to fabricate the vessel for cylindrical as well as spherical vessels? Use given data below

Q.3 Write the difference between an internal pressure vessel and an external pressure vessel. Also, explain the failure mechanism of these pressure vessels. 5 Marks

Q.4 Discuss the stress analysis of different types of lap weld joints. Single transverse lap joint, double transverse lap joint and parallel joint. 5 Marks

Q.5 Suppose, the current domestic LPG cylinder has various problems like a heavy weight, unergonomic design, etc. Now you must redesign this pressure vessel according to the present market demand. Discuss the various steps followed in detail. 5 Marks

Or

Discuss the case study of the pressure vessel, you have studied in the PED lab.

APPENDIX A

(*Clause* 2.2.1.1)

ALLOWABLE STRESS VALUES FOR FERROUS AND NON-FERROUS MATEF

Material Specification	Grade or Designation	Allowable Stress Values in kgf/mm² at Design Temperature in °C												
		Up to 200	Up to 250	Up to 300	Up to 350	Up to 375	Up to 400	Up to 425	Up to 450	Up to 475	Up to 500	Up to 525	Up to 550	Up to 575
IS 2002-1962	1	9·5	8·2	7·8	7·5	7·2	5·9	4·3	3·6	–	–	–	–	–
IS 2002-1962	2A	9·8	9·0	8·1	7·5	7·4	5·9	4·3	3·6	–	–	–	–	–
IS 2002-1962	2B	12·1	11·1	10·0	9·2	8·3	5·9	4·3	3·6	–	–	–	–	–
IS 2041-1962	20Mo2	10·3	10·2	9·3	8·9	8·5	8·2	6·0	5·2	3·6	3·7	–	–	–
IS 2041-1962	20Mo2	10·0	9·8	9·6	9·0	8·3	5·9	4·3	3·6	–	–	–	–	–
IS 1570-1961	15Cr9Mo55	9·0	8·2	8·1	8·0	7·6	7·6	6·6	6·5	5·8	3·5	–	–	–
IS 1570-1961	C14Mo55	9·7	9·2	8·9	8·4	8·1	5·9	4·3	3·6	–	–	–	–	–

TABLE 1.1 CLASSIFICATION OF PRESSURE VESSELS

(*Clause* 1.3.1.1)

Requirement	Class 1	Class 2	Class 3		
(2)	(3)	(4)	(5)	(6)	(7)
Weld joint efficiency factor (*J*)	1·00	0·85	0·70	0·60	0·50
Radiography	Fully radiography	Spot radiography	No radiography	No radiography	No radiography
b) Shell or end plate thickness	No limitation on thickness	Maximum thickness 38 mm after adding corrosion allowance	Maximum thickness 16 mm before corrosion allowance is added	Maximum thickness 16 mm before corrosion allowance is added	Maximum thickness 16 mm before corrosion allowance is added
Type of joints	i) Double welded butt joints with full penetration excluding butt joints with metal backing strips which remain in place	i) Double welded butt joints with full penetration excluding butt joints with metal backing strips which remain in place	i) Double welded butt joints with full penetration excluding butt joints with metal backing strips which remain in place	i) Single welded butt joints with backing strip not over 16 mm thickness or over 600 mm outside dia	i) Single full fillet lap joints for circumferential seams only (*see* 6.3.3.1)
	ii) Single welded butt joints with backing strip *J* = 0·9 (*see* 6.3.3.1)	ii) Single welded butt joints with backing strip *J* = 0·80 (*see* 6.3.4.1)	ii) Single welded butt joints with backing strip *J* = 0·65 (*see* 6.3.4.1)	ii) Single welded butt joints without backing strip *J* = 0·55 (*see* ...)	–

23145

Dr SSB UICET

Sub: S.O.M Class: B.E (Chem) 2nd year M.Marks:25 Date: 22/11/2024

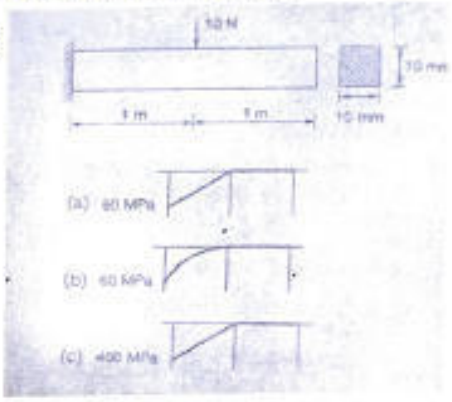
Q.1

(a) For a long column of uniform cross-section, the ratio of critical buckling load for the case with both ends fixed to both ends hinged is .....

(b) A long thin-walled cylindrical shell, closed at both ends, is subjected to an internal pressure. The longitudinal stress developed in the shell is....

(c) .....theories are most suitable for ductile material.

(d) A cantilever beam has a square cross-section of 10mm*10mm. It carries a T.S.L of 10N. Considering only the bottom fibre of the beam, the correct options for the representation of the longitudinal the vibration of the bending stress is..



(e) Write the difference between columns, struts, beam and Shaft.

Q.2 Explain the concept of strain energy and write the difference between resilience, proof resilience, modulus of resilience, and toughness with a diagram.

$\frac{M}{I} = \frac{\sigma}{y}$

$\frac{bd^3}{12}$ bd^3

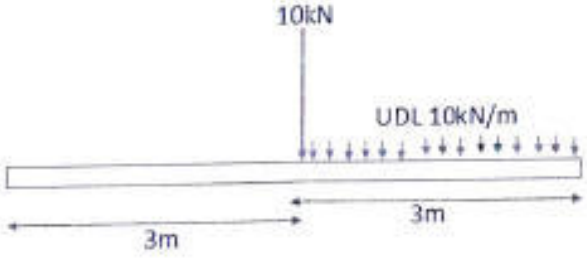
$\frac{M}{I}y = \sigma$

MM3 $\frac{10}{0.833}$ $\times 5 = \sigma$

Q.3 Discuss about the Euler's theory of columns.

Q.4 Discuss the difference between maximum principal stress and maximum shear stress theory with a graphical representation.

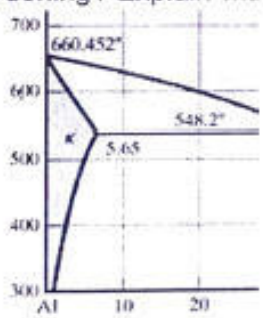
Q.5 A simply supported beam 6m long carries a UDL of 10kN over a length of 3m from the right end and a point load of 10kN at the middle of the span. Draw the shearing force and bending moment diagram. Also, calculate the maximum bending moment.



BE (Chemical) 2nd Year (MST-II, 25th Nov. 2024)

Time allowed: 1.5 hours **Engineering Materials** **M.M.: 25**

Note: In case of any missing data, it can be assumed giving proper justification.

Q. No.	Problem statement	Marks	CO
1.	(i) Draw the schematic phase diagram of Pb – Sn. For equilibrium conditions, determine the number of degrees of freedom for 70 wt% Sn– 30 Pb wt% alloy at room temperature and when the alloy is heated to the eutectic temperature. (ii) Describe the microstructure obtained on cooling of 70 wt% Sn– 30 Pb wt% alloy from the liquid to solid state (room temperature) under equilibrium conditions. Determine the relative amounts of the phases present at 1° below the eutectic temperature.	5	CO3
2.	(i) Explain the difference between white cast iron and gray cast iron? (ii) What is diffusionless transformation? What is the product formed? Describe tempering method to obtain the desired ductility and strength in a carbon steel of eutectoid composition.	5	CO3
3.	(i) Justify your answer whether there would there be a difference in the corrosion of the base metal if there is a pinhole in the coating: a) when the coating is anodic compared to the base metal b) when the coating is cathodic compared to the base metal (ii) Give a brief account of the composition of the following alloys: a) 304 SS b) Hastelloy C-276 c) Monel 400	5	CO4
4.	(i) What is creep? Explain the creep behaviour of metals. (ii) Explain precipitation hardening. What are the effects of precipitation hardening? The relevant part of Al-Cu phase diagram is given below. Would this alloy respond to precipitation hardening? Explain with reference to the phase diagram. 	5	CO4, CO3
5.	Attempt any two: i. What is galvanic corrosion? Explain its mechanism and any one method for its prevention. ii. How is tempered glass different from ordinary glass? Give the composition of soda-lime glass. iii. A tensile load of 100 N is applied to an aluminium-boron composite of 1 mm^2 cross-sectional area. The volume of the parallel boron fibres is 30%. What is the stress in the fibres, when the applied load is: a) parallel to the fibres b) perpendicular to the fibres? Given: $Y_B = 440\ GN/m^2$, $Y_{Al} = 71\ GN/m^2$ iv. Write a brief note on the topic of your presentation. v. Distinguish between the various types of stainless steels.	5	CO4

23145

DR SSB UICET, PANJAB UNIVERSITY, CHANDIGARH

Periodical:1

Class: B.E (Chem.) 2nd year Sub: Strength of Material Max. Marks 25 Time:90 mins

Q.1
1*5=5 Marks

a) The .....material is known for its ability to undergo large deformation before rupturing.

b) List the various mechanical properties of the material.

c) Write the bending moment equation.

e) Write three differences between stress and pressure.

f) if σ_1 and σ_2 are the largest and smallest tensile principal stress respectively. The value of the maximum shear stress is?

Q.2 Derive an expression for the bending moment equation. 5 Marks

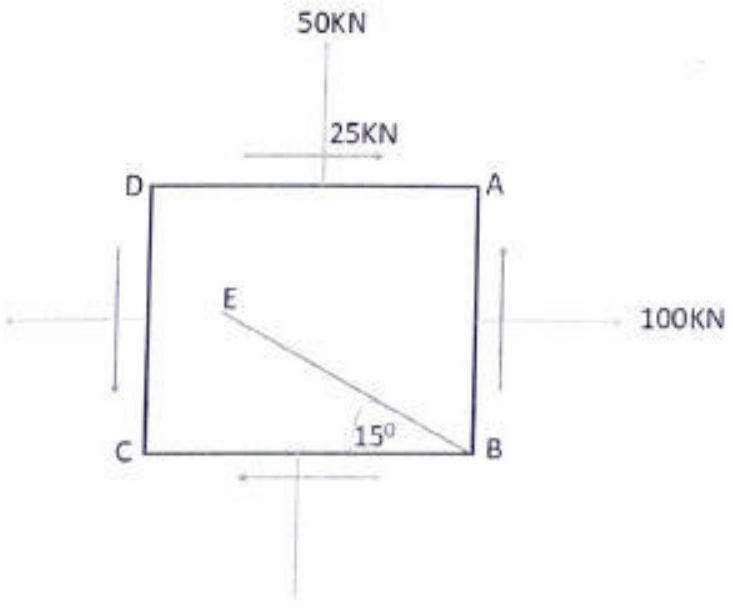
Or

Drive an expression for twisting moment equation

Q.3 Drive the relation between modulus of elasticity (E), modulus of rigidity (G), and Bulk modulus (K). 5 Marks

Q.4 Draw and explain the stress and strain diagram for ductile material. Explain each point in detail. 5 Marks

Q.5 Find the normal stress, shear stress, Maximum shear stress, resultant stress and radius of Mohr's circle for the below-given problem. 5 Marks



Exam.Code:0953
Sub. Code: 34110

2124
B.E. (Chemical) Third Semester
ESC-105: Engineering Materials

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting one question from each Unit.

x-x-x

Q.1 (i) Sketch the slip planes and slip directions in FCC crystal and give the Miller Indices.

(ii) Determine the coordination number and the number of ions per unit cell for NaCl and CsCl.

(iii) Explain the role of chromium in stainless steels.

(iv) Differentiate between tensile strength and yield strength.

(v) What is Gibb's phase rule? (5×2)

UNIT-I

Q.II (i) For a metal '*A*', which has a BCC structure, determine the planar density of atoms in (110) plane and (111) plane. On which plane would slip occur?

Given: radius of atom= 0.137 nm

(ii) Calculate the theoretical density of iron for a BCC iron crystal. The lattice parameter of iron is 2.866×10^{-8} cm, and atomic weight for iron is 55.847 g/mol. Determine the number of vacancies needed for a BCC iron crystal to have a density of 7.874 g/cm^3.

(5,5) CO1

Q. III (i) A metal is known to crystallize in face centered cubic lattice. The length of cubic unit cell is a = 4.070 A°. Determine:

a) the closest distance between atoms

b) its packing fraction

(ii) In FCC iron, carbon atoms are located at octahedral sites whereas in BCC iron, carbon atoms enter tetrahedral sites. The lattice parameter is 0.3571 nm for FCC iron and 0.2866 nm for BCC iron. The radius of carbon atoms is 0.071 nm. Would we expect a greater distortion of the crystal by an interstitial carbon atom in FCC or BCC iron? Explain.

(5,5) CO1

P.T.O.

UNIT-II

Q.IV (i) Draw and explain various one dimensional imperfections. Which of these can cross slip?

(ii) Explain Schmid's Law and derive the expression for resolved shear stress. Determine the critical resolved shear stress for a slip system with λ=70° and ϕ=30°. Slip is found to begin when a stress of 35 MPa is applied. (5,5)CO2

Q. V (i) Explain theFick's second law of diffusion.

A certain mechanical component of carbon steel with 0.35% carbon needs to be surface carburized such that the concentration of carbon at 0.2 mm depth is 1%. The carburizing medium imposes a surface concentration of carbon 1.4%. Determine how long the process of carburization is to be carried out at 900°C (Fe is in FCC form). Some error function values are given below.

Given: $D_{(C \text{ in } Fe)} = 5.25 \times 10^{-12}$ m^2/s,

z	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
erf (z)	0.1680	0.2227	0.2763	0.3286	0.3794	0.4284	0.4755	0.5205

(ii) Differentiate between tilt boundary and twin boundary.

Estimate the distance between dislocations in a tilt boundary of Alumunium if the misorientation angle is 5°. Given lattice parameter of Al = 0.405nm. Crystal structure is FCC. (5,5) CO2

UNIT-III

Q.VI (i) Draw a labelled iron-iron carbide phase diagram and explain the eutectoid and eutectic reactions.

(ii) On slow cooling of eutectoid steel of 0.8 wt% carbon to room temperature, what are the phases present and what is their amount? Explain the microstructure obtained on slow cooling of this steel. (5,5) CO3

Q.VII (i) Draw and explain Pb-Sn phase diagram. Explain the invariant reaction.

For 1 kg of 35-65 wt% Pb-Sn alloy, determine the fraction of the phases

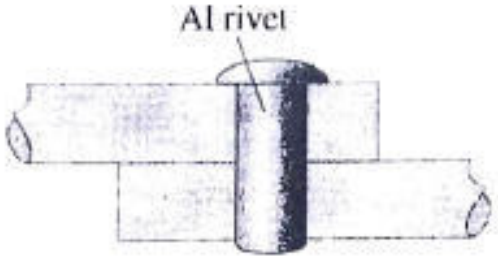
present just 1°C above the eutectic temperature?

(ii) Using TTT curves, describe the tempering process. How is the tempered steel different from austempered steel? (5,5) CO3

UNIT-IV

Q.VIII (i) An underground pipelinecarrying water isto be protected from corrosion. Describe sacrificial anode method for corrosion prevention. Explain with the help of suitable sketch.

(ii) Two sheets of a 1040 carbon steel are joined together with an aluminum rivet. What type of corrosion can take place as a result of this joining process.



(iii) Suggest suitable materials of construction with composition for storing the following:

a) conc. hydrochloric acid

b) conc. sulfuric acid

OR

(iii) For the following materials, write the composition:

a) Monel

b) 18:8 stainless steels (4,2,4)CO4

Q. IX (i) Explain the differences between cathodic and anodic protection and the principle upon which each method is based.

(ii)A 20 mm dia bar of 1040 carbon steel is used as a structural member in an engineering design. The unstressed length of the bar is precisely 1m. The structural load on the bar is 9×10^4 N in tension.

a) What will be the length of the bar under this structural load?

b) A design engineer is considering a structural change that will increase the tensile load on this member. What is the maximum tensile load that can be permitted without producing plastic deformation of the bar?
Given: E=200 GPa, YS=600 MPa, TS=750 MPa, % elongation at failure=17 (5,5)CO4

x-x-x

23145

Exam Code: 0953
Sub. Code: 34109

2124
B.E. (Chemical) Third Semester
ESC-104: Strength of Materials

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: *Attempt five questions in all, including Question No. 1 which is compulsory and selecting one question from each Unit.*

Q1 (i) Define Modulus of Elasticity.

(ii) State the Principle of St. Venant's law of uniform stresses.

(iii) What is thermal stress?

(iv) What do you mean by pure bending?

(v) Differentiate Shearing stress.

(vi) What is thin shells?

(vii) State Euler's theory.

(viii) Define spring constant.

(ix) What is strain energy?

(x) What do you mean by resilience? (10)

UNIT-I

Q2 State Hook's law? At a point in a strained material, the normal tensile stresses are 60 and 30 N/mm^2. Determine by Mohr's circle, the resultant intensity of stress on the plane inclined at 40° to the axis of minor stress. (10)

Q3 What are the different types of supports? A simply supported beam 6 m long carries a point load at the midpoint at an angle of 45°. Draw SF and BM diagrams. (10)

UNIT-II

Q4 What do you mean by composite beam? A simply supported beam of a span of 5m is subjected to a central load of 20 kN. Find max. Slope and deflection of the beam. Take $I=12x10^6$ mm^4 and E=200 GPa. (10)

Q5 a) Derive the expression for deflection of the beam by using Macaulay's method for simply supported beam with load at mid-span. (6)

b) Write a note on the moment area method. (4)

P.T.O.

UNIT-III

Q6 (a) A spherical shell of 4m diameter is subjected to internal pressure of 2 MPa. It is made up of a 20mm thick plate. Find the change in diameter and volume of the shell. Take E=200 GPa and Poisson's Ratio=0.3 (6)

(b) Write a brief note on the stresses in the case of a thin shell. (4)

Q7 What do you mean by composite shaft? Derive the expression for torsion in the case of a circular solid shaft. (10)

UNIT-IV

Q8 Classify springs? A quarter elliptical leaf spring 800 mm long is subjected to a point load of 10 kN. If bending stress and deflection are not to exceed 320 MPa and 80 mm respectively. If the thickness is 13mm and the width is 8 times the thickness then find the number of plates required. Given E= 200 GPa. (10)

Q9 What do you mean by the elastic failure of materials? Write a note on Strain energy due to bending. (10)

x-x-x

UNIT-III

Q6 (a) A spherical shell of 4m diameter is subjected to internal pressure of 2 MPa. It is made up of a 20mm thick plate. Find the change in diameter and volume of the shell. Take E=200 GPa and Poisson's Ratio=0.3 (6)

(b) Write a brief note on the stresses in the case of a thin shell. (4)

Q7 What do you mean by composite shaft? Derive the expression for torsion in the case of a circular solid shaft. (10)

UNIT-IV

Q8 Classify springs? A quarter elliptical leaf spring 800 mm long is subjected to a point load of 10 kN. If bending stress and deflection are not to exceed 320 MPa and 80 mm respectively. If the thickness is 13mm and the width is 8 times the thickness then find the number of plates required. Given E= 200 GPa. (10)

Q9 What do you mean by the elastic failure of materials? Write a note on Strain energy due to bending. (10)

x-x-x

Exam Code: 953
Sub Code: 7141

1123

Engineering Materials

BE (Chem) 3rd sem with MBA

Time Allowed: 3 hours CHE 305 Max. Marks: 50

Note: Attempt five questions selecting at least two from each section. Missing data can be assumed, if any.

SECTION – A

Q.I (i) Define the term unit cell. Draw a neat sketch of BCC, FCC and HCP unit cells. Compute their coordination numbers.

(ii) At the same temperature α-iron has BCC structure and γ-iron has FCC structure with a higher packing factor. Still γ-iron can hold more carbon than α-iron. Why?

(iii) Explain the significance of the following:

[111], (111), {111}, <111>

(4,4,2)

Q.II (i) The lattice parameter of a material with FCC structure is given to be 4.05A°. On which plane slip is likely to occur: (111) or (110)? Give justification.

(ii) Calculate the diameter of the largest atom which can fit interstitially into an FCC copper crystal without distorting it. The lattice parameter for copper is 3.61 A°. Also calculate the density of copper. (At. Wt. 63.5)

(iii) A material has a cubic unit cell with one atom per lattice point. If $a_o = 4.0786$ A° and r = 1.442 A°, determine the crystal structure. (4,4,2)

Q.III (i) Give examples of five types of point defects in a crystal lattice and explain how they help atom diffusion within the crystal?

(ii) The surface of 0.1% C steel is to be strengthened by carburizing. The steel is placed in an atmosphere that provides a maximum of 1%C at the surface of the steel at a high temperature. It is desirable that steel must contain 0.5% C at a depth of 2mm below the surface. How long will carburizing take if the diffusion coefficient is 2×10^{-11} m^2/s?

z	0.4	0.45	0.5	0.55	0.6	0.65
erf (z)	0.4284	0.4755	0.5205	0.5633	0.6039	0.6420

(5, 5)

P.T.O

Q.IV (i) Explain why generally mechanical working at ordinary temperatures hardens a metal and state the circumstances when such working fails to harden a metal.

(ii) What is Schmidt's Law? Discuss its importance. (5, 5)

SECTION - B

Q.V (i) Draw a labeled iron-carbon phase diagram and explain the phase reactions at the eutectic and eutectoid points.

(ii) Draw TTT diagrams for the following and differentiate between the structure and properties of steel obtained:

(a) tempering
(b) austempering and
(c) martempering. (5,5)

Q. VI (i) What are the various causes of galvanic corrosion? Explain.

(ii) How do materials become passive to corrosive environment?

(iii) Indicate two ways to protect underground pipelines from corrosion. (4,3,3)

Q.VII (i) Define endurance limit in fatigue test. What is the use of S-N curve?

(ii) Explain the term toughness. Describe a suitable method to determine the toughness of a material. (5,5)

Q.VIII (i) Suggest suitable materials of construction for storing the following:

(a) conc. KOH

(b) fuming nitric acid

(c) acetic acid

(d) conc. sulfuric acid

(e) dil. hydrochloric acid (5)

(ii) Write short notes on any two:

(a) cast iron: types and applications

(b) polymers and composites: properties and uses

(c) creep failure (5)

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(Chemical) Third Semester
CHE-305: Engineering Materials

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, selecting atleast two questions from each Section.*

x-x-x

SECTION – A

Q.1 (i) Discuss the various crystal systems. Determine the packing factor for hexagonal close packed structure.

(ii) What are Miller indices? Draw the following in a cubic unit cell:

(121), [111], [101], (101), (100) (5,5)

Q.2 (i) Discuss with the help of suitable sketches:

twin boundary, screw dislocation

(ii) Determine the size for an atom that just fits into a tetrahedral site without disturbing the surrounding atoms. (5,5)

Q.3 (i) Discuss the Fick's first law of diffusion and explain the diffusion phenomenon in solids.

(ii) The surface of 0.1% C steel is to be strengthened by carburizing. The steel is placed in an atmosphere that provides a maximum of 1.2%C at the surface of the steel at a high temperature. It is desirable that steel must contain 0.45% C at a depth of 2mm below the surface. How long will carburizing take if the diffusion coefficient is 2×10^{-11} m^2/s? The following data can be used.

z	0.5	0.55	0.6	0.65	0.7	0.75
erf (z)	0.5205	0.5633	0.6039	0.6420	0.6778	0.7112

(5,5)

Q.4 (i) The lattice parameter of aluminum having face centered cubic structure is known to be 4.05 A°. Determine the planar density for (111) and (110) planes and identify the plane on which slip would occur.

(ii) Describe the various methods of strengthening materials. (5,5)

P.T.O.

Section - B

Q.5 (i) Differentiate between eutectic and eutectoid phase reactions with suitable examples.

(ii) It is given that Metal A and metal B have melting points of 1250°C and 800°C respectively, and are completely soluble as liquids but only partially soluble as solids forming two solid solutions α and β. These solid solutions form a eutectic at 620°C containing 62% B and 38% A. The following table shows the maximum solubilities of each metal in the other under equilibrium conditions over a range of temperatures:

Temperature (°C)	0	100	200	300	400	500	600	620
Max solubility of B in A(%wt)	5.0	6.5	8.3	10.4	13.0	16.4	22.3	24.0
Max solubility of A in B(%wt)	1.0	1.4	1.8	2.4	3.3	4.6	6.4	7.0

i. Draw the thermal equilibrium diagram for the system on a graph paper and label all the regions.

ii. Calculate the proportions of phases in 70%A / 30%B alloy at a temperature of 800 °C

iii. Describe the structure that would be obtained if 85%A / 15%B were cooled slowly to 700 °C and then quenched in cold water. (4,6)

Q.6 (i) Explain TTT curve with reference to eutectoid steel and describe the tempering process. What change in properties will take place? Discuss.

(ii) Differentiate between hot and cold working.

(iii) What is creep? Explain the mechanism of creep failure in ductile materials. (4,3,3)

Q.7 (i) Briefly explain composites and their applications with suitable examples.

(ii) Explain the following terms:

Fracture toughness, yield strength, stiffness, toughness, hardness

(iii) Write the composition and applications of the following materials:

a) High silicon iron
b) Hastealloy B2
c) Inconel 600
d) SS 316

(3,3,4)

Q.8 (i) What is galvanic corrosion? Discuss its causes and effects.

(ii) Briefly explain the methods to combat galvanic corrosion.

(5,5)

x-x-x

Exam Code: 934
Sub. Code: 7553

1103

B.E. (Chemical) Third Semester

CHE-305: Engineering Materials

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all selecting at least two questions from each section. Missing data can be assumed, if any.

x-x-x

SECTION - A

Q.I (i) Determine the packing factor of simple cubic (SC), body centered cubic (BCC), face centered cubic (FCC) and hexagonal close packed (HCP) unit cells.

(ii) Show the following in a cubic unit cell:

[131], (101), (321), (1-11)

(iii) Write close packed directions and planes in FCC cubic unit cell

(4,4,2)

Q.II (i) With the help of neat diagram and using Burger's circuit, explain the various line defects in a crystal lattice. How does slip occur in metals?

(ii) Determine the interplanar spacings and planar density for (111) and (110) planes in FCC. The lattice parameter of FCC aluminum is 4.05 A°. Based on your calculations, specify on which plane would slip occur? (5,5)

Q.III (i) Explain the phenomenon of diffusion in solids.

(ii) Determine the radii ratio for an atom that just fits into an tetrahedral site without disturbing the surrounding atoms. (5,5)

Q.IV (i) Explain Schmid's Law. Determine the critical resolved shear stress for a slip system with $\lambda=70°$ and $\phi=30°$. Slip is found to begin when a stress of 35 MPa is applied.

(ii) Write short notes on:

a. methods of strengthening materials
b. effect of directionality of bonds on the mechanical properties of materials

(5,5)

Sub Code: 1[illegible]

Section - B

Q.V (i) Draw a neat labeled Fe-Fe_3C phase diagram and explain the phase reactions at the eutectic and eutectoid points, giving composition of each phase.

(ii) Explain the microstructure obtained for a hypoeutectoid steel when it is slowly cooled to room temperature.

(5,5)

Q.VI (i) What is bainite and how is it obtained? In what way it is different from pearlite?

(ii) Distinguish between hot and cold working. (5,5)

Q. VII (i) Briefly explain the AISI-SAE designation system for carbon steel with suitable examples.

(ii) What are stainless steels and how are they superior to carbon steel? Discuss the various types of stainless steels by giving their composition.

(iii) Describe the tensile testing of metals and define the following terms:

proof stress, ductility, toughness and stiffness

(3,3,4)

Q.VIII (i) Suggest suitable materials of construction and write their composition for storing the following:

(a) caustic soda

(b) conc. nitric acid

(c) conc. sulfuric acid

(ii) Briefly explain pitting corrosion and the measures that can be taken to avoid it.

(iii) Discuss the ways to protect the underground pipelines from corrosion.

(3,3,4)

Exam Code: 934
Sub. Code: 7553

1103

B.E. (Chemical) Third Semester
CHE-305: Engineering Materials

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all selecting at least two questions from each section. Missing data can be assumed, if any.

x-x-x

SECTION - A

Q.I (i) Determine the packing factor of simple cubic (SC), body centered cubic (BCC), face centered cubic (FCC) and hexagonal close packed (HCP) unit cells.

(ii) Show the following in a cubic unit cell:

[131], (101), (321), (1-11)

(iii) Write close packed directions and planes in FCC cubic unit cell

(4,4,2)

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(ii) Write short notes on:

a. methods of strengthening materials
b. effect of directionality of bonds on the mechanical properties of materials (5,5)

P.T.O.

Section - B

Q.V (i) Draw a neat labeled Fe-Fe_3C phase diagram and explain the phase reactions at the eutectic and eutectoid points, giving composition of each phase.

(ii) Explain the microstructure obtained for a hypoeutectoid steel when it is slowly cooled to room temperature.

(5,5)

Q.VI (i) What is bainite and how is it obtained? In what way it is different from pearlite?

(ii) Distinguish between hot and cold working. (5,5)

Q. VII (i) Briefly explain the AISI-SAE designation system for carbon steel with suitable examples.

(ii) What are stainless steels and how are they superior to carbon steel? Discuss the various types of stainless steels by giving their composition.

(iii) Describe the tensile testing of metals and define the following terms:

proof stress, ductility, toughness and stiffness

(3,3,4)

Q.VIII (i) Suggest suitable materials of construction and write their composition for storing the following:

(a) caustic soda

(b) conc. nitric acid

(c) conc. sulfuric acid

(ii) Briefly explain pitting corrosion and the measures that can be taken to avoid it.

(iii) Discuss the ways to protect the underground pipelines from corrosion.

(3,3,4)

Exam. Code: 953
Sub. Code: 7141

1064

BE (Chem) 3rd sem

CHE 305 **Engineering Materials**

Time Allowed: 3 hours Max. Marks: 50

Note: Attempt five questions selecting at least two from each section. Missing data can be assumed, if any.

SECTION – A

Q.I (i) Differentiate between directional and non-directional bonds. How does the directionality of bonds affect the mechanical properties of materials?

(ii) At the same temperature α-iron has BCC structure and γ-iron has FCC structure with a higher packing factor. Still γ-iron can hold more carbon than α-iron. Why?

(iii) Show the following in a simple cubic cell:

(110), [111], (123), [101] (4,4,2)

Q.II (i) Determine the Miller Indices of crystal planes and directions in a material with FCC structure on which slip is likely to occur and sketch in a cubic crystal.

(ii) Determine the radii ratio for an atom that just fits into a tetrahedral site without disturbing the surrounding atoms.

(iii) Silicon (atomic wt. 28.09) has a diamond cubic structure with a lattice parameter of 5.42 A°.Calculate the atomic packing factor and density of silicon.

(4,4,2)

Q.III (i) With the help of neat diagram, explain the various line defects in a crystal lattice.

(ii) There are 0.19 atom % copper at the surface layer and 0.18 atom % copper at a layer 1.2 mm below the surface in a sample of aluminum. Calculate the flux of copper atoms from the surface inwards at 500°C. The aluminum has fcc structure with lattice constant of 0.4049 nm and copper has a diffusivity of 4×10^{-14} m^2/s under operating conditions. Calculate flux in atoms/mm^2-s units. (Density of Al is 2.708 g/ m^3, and its atomic mass is 26.98 g)

(5, 5)

Q.IV Write short notes on any two:

(i) various methods of strengthening materials

(ii) Schmidt's Law

(iii) diffusion mechanism in solids

(5, 5)

SECTION - B

Q.V (i) Draw Iron-Carbide equilibrium phase diagram and mark on it all salient temperature and composition fields. Explain the invariant phase reactions.

(ii) Draw a TTT diagram for eutectoid steel. Describe the tempering heat treatment and briefly discuss the properties of the tempered steel. (5,5)

Q. VI (i) Discuss the various types of galvanic cells responsible for corrosion, giving suitable examples.

(ii) Explain the method of cathodic protection, giving at least two examples, for prevention and control of corrosion. (5,5)

Q.VII (i) Draw a stress – strain curve for a ductile material as obtained in a tensile test and explain the following terms:

Yield stress, tensile strength, stiffness, toughness, proof stress

(ii) Define endurance limit in fatigue test. What is S-N curve?

(ii) What is creep? Explain the mechanism of creep failure of metals. (4,3,3)

Q.VIII (i) Suggest suitable materials of construction for storing the following:

(a) caustic soda (b) conc. nitric acid

(c) dil hydrochloric acid (d) conc. sulfuric acid (4)

(ii) Write short notes on any two:

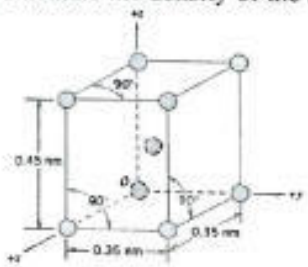
(i) types and composition of stainless steels

(ii) unified alloy numbering system

(iv) composites: properties and applications with examples (3,3)

Engineering Materials
BE (Chem), 3rd semester

Time Allowed: 1.5 hours **Max. Marks: 25**

Q No	Problem statement	CO	Marks
I.	i. A metal crystallizes in BCC structure. Calculate the lattice constant, given that the atomic weight and density for the metal are 6.94 and 530 kg/m³ respectively. ii. Sketch the following in a cubic unit cell (each in a separate unit cell): (001), (211), $[\bar{1}11]$, $(1\bar{2}0)$, (301), [011]	CO 1	1.5×2
II.	The accompanying figure shows a unit cell for a hypothetical metal. (a) To which crystal system does this unit cell belong? (b) What would this crystal structure be called? (c) Calculate the density of the material, given that its atomic weight is 141 g/mol. 	CO 1	3
III.	In FCC crystal structure, interstitial site is located at the centre of each edge. Identify the interstitial site. Compute the radius *r* of an impurity atom that will just fit into one of these sites in terms of the atomic radius *R* of the host atom.	CO 1	3
IV.	Suppose that $CaCl_2$ is added as an impurity to CaO. If the Cl^- substitutes for O^{2-}, what kind of vacancies would you expect to form? How many of the vacancies are created for every Cl^- added?	CO 2	3
V.	Calculate the number of vacancies per cubic meter at 1000°C for a metal that has an energy for vacancy formation of 1.22 eV/atom, a density of 6.25 g/cm³, and an atomic weight of 37.4 g/mol. Given $k=8.62\times10^{-5}$ eV/K	CO 2	3
VI.	Atomic radius, crystal structure, electronegativity, and the most common valence are tabulated in the following table for several elements; for those that are nonmetals, only atomic radii are indicated. Which of these elements would you expect to form the following with copper: (a) A substitutional solid solution having complete solubility (b) A substitutional solid solution of incomplete solubility (c) An interstitial solid solution	CO 2	3
VII.	Differentiate between (draw neat sketches, wherever required): i. Twin and a twin boundary ii. Low angle and a high angle grain boundary Would you expect the grain boundary energy of a small-angle grain boundary greater than, the same as, or less than for a high-angle one? Why?	CO2	3
VIII.	The surface of 0.24 wt% C steel is to be strengthened by carburizing. The steel is placed in an atmosphere that provides a maximum of 1.2 wt %C at the surface of the steel. It is desirable that steel must contain 0.6% C at a depth of 1 mm below the surface. How long will carburizing take if the diffusion coefficient is 2.98×10^{-11} m²/s? The following data can be used:	CO2	4

Element	Atomic Radius (nm)	Crystal Structure	Electronegativity	Valence
Cu	0.1278	FCC	1.9	+2
H	0.046			
O	0.060			
Ag	0.1445	FCC	1.9	+1
Al	0.1431	FCC	1.5	+3
Ni	0.1246	FCC	1.8	+2
Zn	0.1332	HCP	1.6	+2

z	0.4	0.45	0.5	0.55	0.6	0.65	0.7
erf (z)	0.4284	0.4755	0.5205	0.5633	0.6039	0.6420	0.6778

DR SSB UICET, PANJAB UNIVERSITY, CHANDIGARH

Periodical:1

Class: B.E (Chem.) 2nd year Sub: Strength of Material Max. Marks 25 Time:90 mins

Q.1

1*5=5 Marks

a) The .....material is known for its ability to undergo large deformation before rupturing.

b) List the various mechanical properties of the material.

c) Write the bending moment equation.

e) Write three differences between stress and pressure.

f) if σ_1 and σ_2 are the largest and smallest tensile principal stress respectively. The value of the maximum shear stress is?

Q.2 Derive an expression for the bending moment equation. 5 Marks

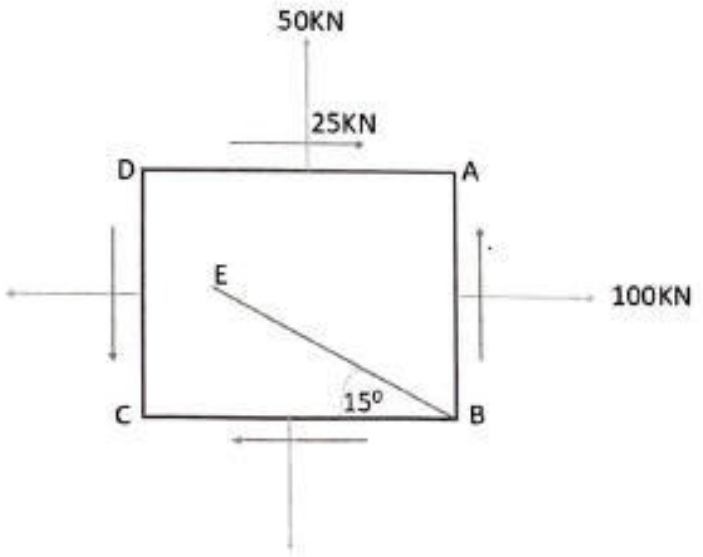
Or

Drive an expression for twisting moment equation

Q.3 Drive the relation between modulus of elasticity (E), modulus of rigidity (G), and Bulk modulus (K). 5 Marks

Q.4 Draw and explain the stress and strain diagram for ductile material. Explain each point in detail. 5 Marks

Q.5 Find the normal stress, shear stress, Maximum shear stress, resultant stress and radius of Mohr's circle for the below-given problem. 5 Marks



B.E. (Chemical) Third Semester
ESC-104: Strength of Materials

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section.

x-x-x

1. Attempt the following:-
   a. State the St. Venant's principle.
   b. What do you mean by principle planes?
   c. Name the different types of beams?
   d. What do you mean by pure bending.
   e. Differentiate Bending stress and Shearing stress.
   f. What do you mean by built up shell?
   g. State Euler's column theory?
   h. Where leaf springs are used?
   i. What do you mean by resilience and proof resilience?
   j. Define slenderness ratio.

(1x10=10)

SECTION-A

2. What do you mean by factor of safety? The principal stresses at a point in a material are 75MPa(Tensile) and 45MPa(Tensile) Find for a plane inclined at 40° to that of former stress the magnitude of normal and tangential stress components. What is the obliquity of the resultant stress on this plane? (10)

3. Define modulus of elasticity and rigidity. A bar 8 m long and 20 mm in diameter hangs vertically and has a collar rigidly attached to the lower end. Find the maximum stress induced when a weight of 150 N falls centrally from a height of 150 mm on the collar. Also find the corresponding extension. Take E= 200 GN/m^2 (10)

4. (a) A cantilever 2 m long carries a load varying from zero at free end and to 50kN/m run at the fixed end. Draw SF and BM diagrams. Also find maximum value of SF and BM. (6)

(b) A cantilever of length 2.2 m is acted upon by two concentrated loads of 22 kN each, one at free end and other 1.2 m from free end. Find slope and deflection at free end. Take EI= 1 x 10^4 kNm^2 (4)

SECTION-B

5. (a) What are the different types of stresses that are induced in case of a thin shell subjected to internal pressure? Prove that stresses will be same in all the directions in case of spherical shell. (6)

(b) A gas cylinder of inner diameter is 8 mm thick. If maximum limit for tensile stress in the material is not to exceed 40 MPa, then find the maximum permissible pressure for this cylinder. (4)

6. Differentiate open coil and closed coil spring. What do you mean by stiffness of a spring? A closed coil helical spring is to have a stiffness of 70 kN/m and to exert a force of 2.25 kN. If the mean diameter of coil is to be 90 mm, and working stress is 230 MN/m^2, find the required number of coils. Take the modulus of rigidity as 80 GN/m^2 (10)

7. (a) Write note on the elastic failure of materials. Explain the Von-mises theory of elastic failure. (5)

(b) What is strain energy? Derive the relation for strain energy due to suddenly applied load. (5)

x-x-x

Exam.Code:0953
Sub. Code: 6871

2122

B.E. (Chemical) Third Semester
ESC-105: Engineering Materials

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section. Missing data can be assumed, if any, with proper justification.

x-x-x

I. Attempt the following:-

i. Determine the crystal structure for a metal with a_0 = 0.42906 nm, r = 0.1858 nm and one atom per lattice point.

ii. What is the coordination number and structure expected for the following compounds: KCl and ZnO
Given $r_K^{1+} = 1.33$ Å, $r_{Zn}^{2+} = 0.74$ Å, $r_O^{2-} = 1.32$ Å, $r_{Cl}^{1-} = 1.81$ Å

iii. How do substitutional impurity atoms affect the strength of metal?

iv. What is a twin boundary? Briefly explain its role in slip process.

v. How would the presence of crack in the coating affect protection to steel if it is coated with zinc and in second case coated with tin?

(2×5)

SECTION – A

II. (i) Draw and identify the Miller Indices of slip directions on (111) plane in an FCC unit cell.

(ii) Determine the repeat distance, linear density, and linear packing fraction for FCC nickel, which has a lattice parameter of 0.35167 nm, in the [100] and [110] directions. Which of these directions is close packed?

(iii) Sketch the following planes and directions within a cubic unit cell (each in a separate unit cell):

(a) $[1\bar{1}0]$ (b) [410] (c) (011) (d) $(\bar{1}21)$

[CO1], (3,3,4)

III. –(i) Briefly explain why small-angle grain boundaries are not as effective in interfering with the slip process as are high-angle grain boundaries.

(ii) An alloy initially has a uniform carbon concentration of 0.25 wt% and is to be treated at 950°C. If the concentration of carbon at the surface is suddenly brought to and maintained at 1.20 wt%, how long will it take to achieve a carbon content of 0.80 wt% at a position 0.5 mm below the surface? The diffusion coefficient for carbon in iron at this temperature is 1.6×10^{-11} m^2/s; assume that the steel piece is semi-infinite. The following error function values are given:

z	0.30	0.35	0.40	0.45
erf (z)	0.3286	0.3794	0.4284	0.4755

[CO2], (5,5)

P.T.O.

IV. (i) Draw and explain the various line imperfections with the help of Burger's circuit. How does plastic deformation occur?

(ii) Explain Schmid's law. Consider a metal single crystal oriented such that the normal to the slip plane and the slip direction are at angles of 60° and 35°, respectively, with the tensile axis. If the critical resolved shear stress is 6.2 MPa, will an applied stress of 12 MPa cause the single crystal to yield? If not, what stress will be necessary?

[CO2], (5,5)

SECTION - B

V. (i) Draw a labelled Fe-Fe_3C phase diagram and explain the eutectoid reaction that occurs. Determine the composition and amount of each phase present at room temperature.

(ii) A steel contains 18% cementite and 82% ferrite at room temperature. Estimate the carbon content of the steel. Is the steel hypoeutectoid or hypereutectoid? Describe its microstructure.

[CO3], (5,5)

VI. *(i) Describe the complete heat treatment required to produce a tempered eutectoid steel.*

a. *Would you expect pearlite to be formed? Explain.*

b. What is the quenched steel known as and what is its structure?

(ii) What is creep? How and why does it take place? Explain creep behavior of metals.

[CO3,CO4], (5,5)

VII. (i) The fatigue data for a steel alloy is given as follows:

Stress Amplitude (MPa)	*Cycles to failure*
470	10^4
440	3×10^4
390	10^5
350	3×10^5
310	10^6
290	3×10^6
290	10^7
290	10^8

(a) Make the *S-N* plot and determine the fatigue limit for this alloy.

(b) If a rod of this alloy is to be used for an automobile axle that is subjected to 2×10^5 cycles of alternating stress continuously, what would be its endurance limit?

(ii) Differentiate between cathodic and anodic protection.

(iii) A cold-worked copper tube is soldered, using a lead-tin alloy, into a steel connector. What types of electrochemical cells might develop due to this connection? Which of the materials would you expect to serve as the anode and suffer the most extensive damage due to corrosion? Explain.

[CO4], (4,3,3)

22146

Exam.Code:0953
Sub. Code: 6871

2123

B.E. (Chemical) Third Semester

ESC-105: Engineering Materials

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section. Missing data can be assumed, if any, with proper justification.

x-x-x

1 i. For the element copper which has FCC structure, determine:(a) the distance of nearest neighbors (b) the interplanar spacing of {110} planes. Given r_{cu}=0.1278 nm

ii. Cobalt (Co) has an HCP crystal structure, an atomic radius of 0.1253 nm, and a c/a ratio of 1.623. Compute the volume of the unit cell for Co.

iii. Describe the phenomenon of passivity with a suitable example.

iv. Derive the expression for modulus of elasticity of a fiber reinforced composite under isostrain condition.

v. Corrosion is found to occur beneath a water droplet on a carbon steel plate. Give a brief explanation.

(2×5)

SECTION – A

II *(i) Determine whether NiO would have cesium chloride, sodium chloride, or zinc blende structure. Based on your answer, determine: (a) the lattice parameter and (b) the packing factor.*

Given:

Element	Atomic Radius (Å)	Valence	Ionic Radius (Å)
Nickel	1.243	+2	0.69
Niobium	1.426	+4	0.74
Nitrogen	0.71	+5	0.15
Oxygen	0.60	–2	1.32

(ii) For FCC crystal structure, identify the interstitial site occupied by impurity atoms located at the center of each edge of the unit cell. Compute the radius *r* of an impurity atom that will just fit into one of these sites in terms of the atomic radius *R* of the host atom.

(iii) Sketch the following planes and directions within a cubic unit cell (each in a separate unit cell):

(a) $[1\bar{1}1]$ (b) (210) (c) (011)

[CO1], (4,3,3)

P.T.O.

Exam Code: 0953
Sub. Code: 6870

2123

B.E. (Chemical) Third Semester

ESC-104: Strength of Materials

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, selecting atleast two questions from each Section.

x-x-x

SECTION-A

Q1 (i) Define Modulus of Elasticity and modulus of Rigidity.

(ii) State the Principle of St. Venant law of uniform stresses and Hook's Law.

(iii) Write a note on Mohr's Circle.

(iv) What do you mean by pure bending.

(v) Differentiate Bending stress and Shearing stress. (10)

Q2 State Hook's law? At a point in a strained material the normal tensile stresses are 60 and 30 N/mm^2. Determine by Mohr's circle, the resultant intensity of stress on the plane inclined at 40 degree to the axis of minor stress. (10)

Q3 (a) A simply supported beam of span 5m is subjected to a central load of 20 kN. Find max. Slope and deflection of beam. Take $I=12x10^6$ mm^4 and E=200 GPa. (5)

(b) Derive the expression for deflection of beam by using Macaulay's method. (5)

Q4 What do you mean by composite beam? A simply supported beam 6 m long carries a point loads at the midpoint at an angle of 45 degree. Draw SF and BM diagrams. (10)

SECTION-B

Q5 (i) Differentiate between thick and thin shells.

(ii) Write any two limitations of Euler's theory.

(iii) How the springs are classified?

(iv) What do you mean by strain energy?

(v) What are the assumptions made for Euler's column theory? (10)

Q6 (a) What do you mean by built up shell and joint efficiency? a) A spherical shell of 4m diameter is subjected to internal pressure of 2 MPa. It is made up of 20mm thick plate. Find change in diameter and volume of shell. Take E=200 GPa and Poisson's Ratio=0.3 (6)

(b) Write a brief note on the stresses in case of thin shell. (4)

P.T.O.

Q7 (a) Briefly discuss the different types of springs (4)

(b) A quarter elliptical leaf spring 800 mm long is subjected to a point load of 10 kN. If bending stress and deflection is not to exceed 320 MPa and 80 mm respectively. If thickness is 13mm and width 8 times thickness then find the number of plates required. Given E= 200 GPa. (6)

Q8 Write note on the following ;

(1) Theories of elastic failure (5)

(2) Strain energy in Torsion (5)

x-x-x

22146

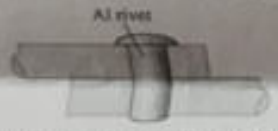
BE (Chemical) 2nd Year (Second Sessional, Dec. 2023)

Engineering Materials

M.M.: 25

Time allowed: 1.5 hours

Note: In case of any missing data, it can be assumed giving proper justification.

No.	Problem statement	Marks	CO
1.	(i) Draw the schematic phase diagram of Cu - Ni. For equilibrium conditions, determine the number of degrees of freedom for 70 wt% Ni – 30 wt% Cu alloy at room temperature and when the alloy is heated to the region lying between liquidus and solidus. (ii) Describe the microstructure obtained on cooling 70 wt% Ni – 30 wt% Cu alloy from the liquid to solid state (room temperature) under equilibrium conditions. Do you expect any change in microstructure if cooling takes place under non- equilibrium conditions? Explain.	5	CO3
2.	What is the difference between cast iron and steels? 1040 steel bar is quenched from austenitic phase to room temperature. What is the product formed known as? Do you expect any problem associated with the quenching process? Recommend and explain with an appropriate schematic the heat treatment required to produce the desired hardness and ductility with least chance of quench cracking in the bar.	5	CO3
3.	(i) Two sheets of a 1040 carbon steel are joined together with an aluminum rivet. Discuss the possible corrosion cells that might be created as a result of this joining process. Recommend a joining process that might minimize corrosion for these cells.  (ii) Determine the Pilling-Bedworth ratio for the following metals and predict the behavior of the oxide that forms on the surface: whether it is protective or is it permeable?	5	CO4
4.	(i) Draw stress *vs* strain curve for: (a) ductile material (b) brittle material, subjected to a tensile test and explain yield strength, tensile strength. (ii) Differentiate between fracture toughness and toughness.	5	CO4
5.	Attempt any two: i. What is pitting corrosion? Explain the mechanism and how can it be prevented. ii. Derive the rule of mixtures for the modulus of elasticity of a fiber reinforced composite when a stress is applied along the axis of the fibers. iii. Suggest suitable material of construction (metals and alloys) for storing: (a) conc H_2SO_4 (b) conc HCl iv. What is tempered glass? How is it different from ordinary glass?	5	CO4

Metal	Metal density (g/cm^3)	Oxide density (g/cm^3)
Mg (Atomic mass = 24.312 g/mol)	1.738	3.60
Ti (Atomic mass = 47.9 g/mol)	4.507	5.10

III (i) Briefly explain the various point defects. How does solid state diffusion take place in crystalline materials?

(ii) An alloy has a uniform initial carbon concentration of 0.10 wt% C. If the concentration of carbon at a distance of 5 mm from the surface required is 0.80 wt% C, how long will it take to achieve this carbon content, if the alloy is carburized in an environment containing 1.0 wt% C? The diffusion coefficient for carbon in iron can be taken as 1.6×10^{-11} m^2/s; assume that the steel piece is semi-infinite. The following error function values are given:

z	0.15	0.20	0.25	0.30	0.35	0.40	0.45
erf (z)	0.1680	0.2227	0.2763	0.3286	0.3794	0.4284	0.4755

[CO2], (5,5)

IV *(i) Draw and explain any three surface imperfections and their role in plastic deformation.*

(ii) Explain Schmid's law. Consider a metal single crystal oriented so that the slip plane is perpendicular to the applied tensile stress. Would the crystal yield? Explain.

[CO2], (5,5)

SECTION - B

V (i) Draw a labelled Fe-Fe_3C phase diagram. Differentiate between eutectic and eutectoid reaction.

(ii) Consider 1 kg of austenite containing 1.15 wt% C, cooled to below 727°C: (a) What is the proeutectoid phase? (b) Determine the amounts of each phase formed (c) Schematically sketch and label the resulting microstructure.

[CO3], (5,5)

VI (i) What is TTT diagram? Differentiate between tempering and martempering heat treatment. With reference to eutectoid steel:

a. Would you expect pearlite to be formed?
b. What is the quenched steel known as and what is its structure?

(ii) Explain fracture toughness. What is its importance?

(iii) In many brittle materials, the normal tensile test cannot easily be performed because of the presence of flaws at the surface. What test would

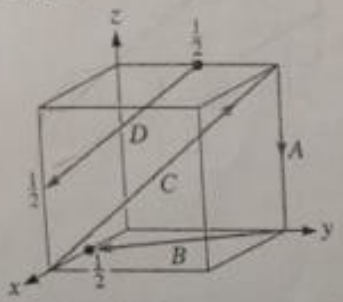
Contd.....P/3

Engineering Materials

...llowed: 1.5 hours

M.M.: 25

Note: In case of any missing data, it can be assumed giving proper justification.

...No.	Problem statement	Marks	CO
1.	The density of potassium, which has the BCC structure, is 0.855 g/cm^3. The atomic weight of potassium is 39.09 g/mol. Calculate (a) the lattice parameter, and (b) the atomic radius of potassium	4	CO1
2.	Determine the Miller indices for the four directions in the cubic unit cell shown in the figure: 	2	CO1
3.	Consider a three-dimensional cubic lattice with a lattice constant equal to *a*. Sketch the following planes (each in a separate unit cell): (i) (100) (ii) (110) (iii) (310) (iv) (232)	2	CO1
4.	a. What is the coordination number for tetrahedral site? Determine the critical radius ratio for a tetrahedral coordination. b. Determine the diameter of the largest atom that would fit an interstitial void in Ni without distortion. Ni has FCC crystal structure with atomic radius as 0.1246 nm.	4	CO1
5.	Calculate the fraction of atom sites that are vacant for copper (Cu) at its melting temperature of 1084°C. Assume an energy for vacancy formation of 120 kJ/mol. Compare this with fraction of atom sites that are vacant at room temperature (25°C).	3	CO2
6.	A certain mechanical component of carbon steel with 0.2% carbon needs to be surface carburized such that the concentration of carbon at 0.2 mm depth is 0.8%. The carburizing medium imposes a surface concentration of carbon 1.2%. Determine how long the process of carburization is to be carried out at 900°C (Fe is in FCC form). Given: D (C in Fe) = 1.4×10^{-11} m^2/s	4	CO2
7.	What do you understand by a tilt boundary? Explain with the help of neat sketch. Calculate the spacing between dislocations in a tilt boundary in FCC nickel, when the angle of tilt is 2°. Given atomic radius of Ni = 0.1246 nm.	4	CO2
8.	Draw a Burgers circuit that encloses a positive edge dislocation in a cubic crystal.	2	CO2

z	0.20	0.25	0.30	0.35	0.40	0.45	0.5
erf (z)	0.2227	0.2763	0.3286	0.3794	0.4284	0.4755	0.5205

you recommend to determine the material's strength? Explain the test with suitable sketch and the test results that would be available.

[CO3,CO4], (5,2.5, 2.5)

VII (i) What is crevice corrosion? Explain with suitable example. Discuss the mechanism and how it can be prevented.

(ii) How can a buried pipeline be protected from corrosion. Explain the method.

(iii) A straight tube of 16 mm uniform bore and 2 mm radial thickness is subjected to an axial tensile stress of 78.5 MN/m^2. Determine the tensile load carried by the tube and the elongation over a 5m length. Young's modulus for the material is 100 GN/m^2.

[CO4], (4,3,3)

x-x-x

22146

Dr. SSBUICET, Panjab University, Chandigarh.

Subject: Strength of Materials **Class: BE Chemical (3rd Sem)** **M.M: 25**

Note: Attempt all questions.

Question 1: (1 mark each)

(a) Write the expression of moment area method to find the deflection of the beam.

(b) Write the classification of springs.

(c) What do you mean by resilience and proof resilience?

(d) Define slenderness ratio.

(e) Write the torsion equation?

Question 2: (5 marks each)

(f) A hollow shaft having 50mm outer diameter and 30mm internal diameter, is subjected to 1.6 kNm torque which produce a twist of 0.4 degree measured on a length of 0.2m of the shaft. Calculate maximum power which could be transmitted by the shaft at 2000 rpm, if maximum allowable shearing stress is 65 MN/m^2.

(g) A Closed coil helical spring made up of circular wire of 10 mm in diameter, has 16 coils with 60mm mean diameter. It is subjected to an axial load of 100 N. Find the deflection of the spring and the maximum shear stress induced in spring. Take modulus of rigidity as 90 GPa.

(h) What are the various assumptions made while driving Euler's formula for long columns? Also state the limitations for the use of Euler's formula.

(i) Derive the expression for strain energy due to simple shear.

Dr. SSBUICET, Panjab University, Chandigarh.

Subject: Strength of Materials **Class: BE Chemical (3rd Sem)**

Max. Marks: 25

Note: Attempt all questions.

Question 1: (1 mark each)

(a) Distinguish between longitudinal and lateral strain. (CO1)
(b) State and explain Poisson's ratio. (CO1)
(c) What do you understand by 'point of contraflexure'. Does it exist in a cantilever? (CO1)
(d) What do you mean by flitched beams? Show a flitched beam with a sketch. (CO2)
(e) What is do you mean by pure bending? (CO2)

Question 2: (5 marks each)

a) Derive the expression for diametral strain in a thin cylindrical shell. (CO3)
b) A simply supported beam of length 10 m carries point load of 5 kN each a distance of 3 m & 7 m from left support and also a UDL of 1 kN between the point loads. Draw S.F & B.M diagrams for the beam. (CO1)

Question 3: (10 marks)

An element in a stressed material has tensile stress of 500 MN/m^2 and a compressive stress of 350 MN/m^2 acting on two mutually perpendicular planes and equal shear stresses of 100 MN/m^2 on these planes. Find principal stresses and position of principal planes by using analytical expressions. Also find maximum shearing stress. (CO1)

Dr. S.S. Bhatnagar U.I.C.E.T. Panjab University, Chandigarh
Heat Transfer (PCC105)
Class: B.E. (Chemical Engineering)-2nd year

Maximum Marks: 25 **Time: 90 Minutes** **Date: 23/04/2024**

Attempt all questions.

In case of missing data, please make reasonable assumptions, state them, and proceed.

Q.1 A shell and tube steam condenser is to be constructed of 2.5 cm OD, 2.2 cm ID, single pass horizontal tubes with steam condensing at 54 degrees C on the outside of the tubes. The cooling water enters at 20 degrees C and leaves at 36 degrees C at a flow rate of 1 kg/s. The heat transfer coefficient for the condensation of steam is 7900 W/m^2 K.
Calculate the tube length, if the latent heat of condensation is 2454 kJ/kg, calculate the condensation rate per tube. *The properties of water are as follows:*
Specific heat 4180 J/Kg K, viscosity 0.86 *10^{-3} kg/ m s., Thermal Conductivity 0.61 W/m K.

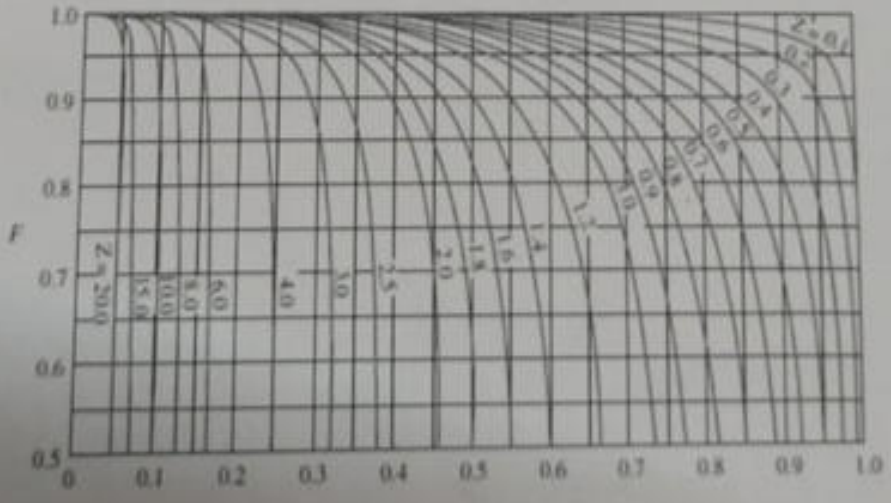
The heat transfer coefficient for turbulent flow in a pipe may be determined by

$$Nu = 0.023\,\mathrm{Re}^{0.8}\,\mathrm{Pr}^{0.4}$$ **(6)**

Q.2 Using Nusselt's film theory, obtain an expression to determine the average heat transfer coefficient during condensation on a vertical tube. State the assumptions involved. **(6)**

Q3. a. With the help of a typical experimental boiling curve explain the different regimes of pool boiling.
b. Explain the working of the 2-4 shell and tube heat exchanger with the help of a neat diagram. **(3+4)**

Q.4 Determine the heat transfer surface area required for a heat exchanger constructed from a 0.0254-*m-OD tube to cool 6.93 kg/s of a* 95% ethyl alcohol solution (cp = 3810 J/kg K) from 65.6°C to 39.4°C, *using 6.30 kg/s of water* ((cp = 4180 J/kg K) available at 10°C. Assume that the overall coefficient of *heat transfer* based on the outer-tube area is 568 W/m^2 K and consider each of the following *arrangements:*
(a) Parallel-flow tube and shell
(b) Counterflow tube and shell
(c) Counterflow exchanger with 2 shell passes and 72 tube passes, the alcohol flowing through the shell and the water flowing through the tubes. **(6)**



22146

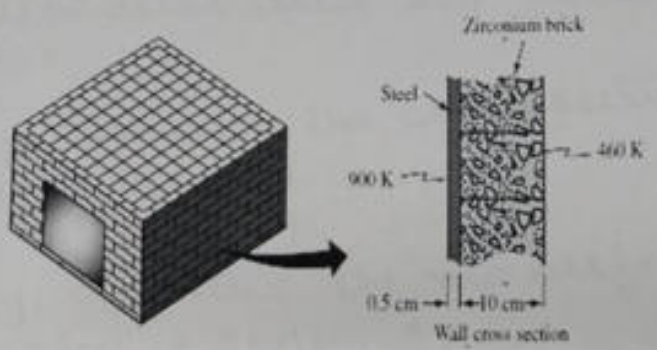
Dr. S.S. Bhatnagar U.I.C.E.T. Panjab University, Chandigarh
Heat Transfer (PCC105)
Class: B.E. (Chemical Engineering)-2nd year

Maximum Marks: 25 **Time: 90 Minutes** **Date: 12/03/2024**

In case of missing data, please make reasonable assumptions, state them, and proceed.

Q.1. Obtain the expressions for steady-state temperature profile and heat transfer rate in a hollow cylindrical container having length 2L. The inner surface ($r = r_i$) is maintained at ($T = T_i$) and the outer surface ($r = r_o$) is maintained at ($T = T_o$). **(6)**

Q.2. Calculate the rate of heat loss from a furnace wall per unit area. The wall is constructed from an inner layer of 0.5-cm-thick steel (k=40W/m K) and an outer layer of 10-cm zirconium brick (k=2.5W/m K) as shown in Figure. The inner surface temperature is 900 K and the outside surface temperature is 460 K. What is the temperature at the interface?



(5)

Q.3. *Derive the expression for heat transfer in fins in the case of rectangular plate fin of uniform cross-section with the insulated end.* (6)

Q.4. a. What are the primary dimensionless groups involved in characterizing free convection heat transfer, and how do they influence the heat transfer process?

b. A fine wire having a diameter of 0.02 mm is maintained at a constant temperature of 54◦C by an electric current. The wire is exposed to air at 1 atm and 0◦C. Calculate the electric power necessary to maintain the wire temperature if the length is 50 cm.

Properties of the air at (27 degrees C)

Kinematic viscosity (v) =15.69×10−6 m^2/s, thermal conductivity (k) = 0.02624 W/m· ◦C, Pr=0.708

$$Nu_d = 0.36 + \frac{0.518(Gr_d\,Pr)^{1/4}}{[1 + (0.559/Pr)^{9/16}]^{4/9}}$$

(3+5)

Or

Q.4. In the lower portion of a spray tower, urea pellets (diameter D 2 mm) are cooled by air at a temperature T_a =20 degrees C. The pellets are falling at their terminal velocity of 6.9 m/s. The urea within the pellets is uniform at all times and the initial temperature of the pellets is 80 degree C. The heat transfer coefficient h for a pellet falling in air is 208 W/m^2 K.

(a) Obtain an expression for the change of temperature of a pellet with time T (t)

(b) Calculate the height of the tower for a pellet to cool to 60 degrees C. **(3+5)**

Exam. Code: 0954
Sub. Code: 6881

2054

B.E. (Chemical) Fourth Semester
PCC- 105: Heat Transfer
(Common with Chemical with MBA and FT)

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: ***Attempt <u>five</u> questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section. In case of missing data, it may be assumed with proper justification.***

x-x-x

Q 1 i. Draw the thermal circuit and write the expression for heat flow for steady state conduction of heat through a cylindrical system exposed to cold air, with hot fluid flowing inside the tube. 2×5

ii. Explain the physical significance of Grashof number.

iii. Define heat exchanger effectiveness.

iv. Radiation plays a significant role in film boiling or nucleate boiling? Why?

v. Why does the heat transfer coefficient increase with the increase in velocity of fluid through a tube?

Section-A

Q 2a Derive an expression for temperature distribution in a one dimensional steady state heat conduction in a plane wall having uniformly distributed heat source, with one face maintained at temperature T_1, while the other face maintained at T_2. The thickness of the wall may be taken as 2L. 5 CO1

b The exterior wall of a house consists of 10 cm layer of common brick (k = 0.7 W/m.°C) , followed by a 3.75 cm layer of gypsum plaster (k = 0.48 W/m.°C). What thickness of the loosely packed rock-wool insulation (k = 0.065 W/m.°C) should be added to reduce the heat loss through the wall by 80%? 5 CO1

Q 3a Derive an expression for rate of heat transfer from a straight rectangular fin protruding from a flat wall maintained at a constant temperature. Consider the end of fin to be insulated. 5 CO1

b A straight fin of rectangular profile has a thermal conductivity of 14 W/m.°C, thickness of 2 mm and length of 23 mm. The base of the fin is maintained at a temperature of 220°C while the fin is exposed to a convection environment at 23°C with h = 25 $W/m^2.°C$. Determine the heat lost per meter of fin depth. 5 CO1

Q 4 a A long pipe 5 cm in diameter passes through a room and is exposed to air at atmospheric pressure and temperature of 20°C. The pipe surface temperature is 93°C. Assuming that the emissivity of the pipe is 0.6, calculate the radiation heat loss per meter of length of pipe. 5 CO1

b A vertical plate of 4m height maintained at 60°C is exposed to atmospheric air at 10°C. Determine the rate of heat transfer, taking the width of plate as 10m. 5 CO1

Properties of air at film temperature can be taken as:

$\nu = 16.5 \times 10^{-6}\ m^2/s$, Pr = 0.7

The following correlation may be used:

$Nu = 0.10\ (Ra)^{1/3}$

BE (Chemical)-MBA, Sem-4th (MST-1)
Production and Operations Management (MBA

Max. Marks: 25 **Max Time: 90 minutes**

Note: All questions are compulsory

1. Sigma Instruments Ltd is considering three locations for its factory- Faridabad, Kolkata and New Delhi. The estimates of different costs for three location options are as mentioned below:

	Faridabad	Kolkata	New Delhi
Transportation Cost (Rs/unit)	10	20	9
Cost of materials (Rs/unit)	120	110	100
Taxes (Rs. per year)	40,000	35,000	45,000
Cost of construction of the factory (Rs.)	5 million	4 million	4.7 million
Electricity (Rs. per year)	22,000	15,000	25,000
Labour (Rs. per unit)	26	21	23

The company has financed the construction cost of the factory by a loan from the State Bank of India at 15% interest per annum. Find economically best option for the production of 5000-10000 units. (10 marks)

2. Differentiate between product and process layout. Also discuss the significance of each type

   Or

   What is quality function deployment and how is it used in product design? Write all steps in detail using a suitable example (10 marks)

3. Define
   a. Job-shop process
   b. Production and operations management
   c. Manufacturability
   d. Concurrent engineering
   e. Standardization (5 marks)

Periodical Examinations, March 2025

Engineering Materials

Chemical Engg with MBA, 3rd Semester

Time: 1.30 hr **Max. Marks: 30**

Note: Attempt All.

Q.1 (2x5)

(a) The lattice constant of aluminium is **4.05 Å**. Determine the atomic radius of aluminium, assuming an **FCC structure**.

(b) What is meant by single-phase, multi-phase, single-crystal, and polycrystal materials? Provide an example of each.

(c) Define and differentiate between interstitial and substitutional solid solutions.

(d) Why are bulk metallic glasses (BMGs) generally multi-component systems?

(e) In an FCC metal, a slip plane has an interplanar spacing of **0.2 nm**. If the applied shear stress is **50 MPa**, what is the resolved shear stress on the slip plane with a Schmid factor of **0.4**?

Q.2

(a) Explain Fick's second law of diffusion and discuss its significance in materials engineering. (4)

(b) A diffusion couple experiment is conducted at **900 °C**, and the diffusion coefficient of a metal in another is found to be **1.5×10^{-12} m²/s**. If the concentration gradient is **2×10^{4} atoms/m**, what is the diffusion flux? (3)

(c) The diffusion coefficient of **copper in aluminum** at **500 °C** is **5×10^{-14} m²/s**. If the diffusion activation energy is **120 kJ/mol**, what is the diffusion coefficient at **700 °C**? Take **R = 8.314 J/mol-K**. (3)

Q.3

(a) Explain the Hall-Petch relationship and its importance in material strengthening. (4)

(b) A metal sample undergoes grain size strengthening. If the initial grain size is **10 µm** and is reduced to **5 µm**, by what factor does the yield strength increase, assuming the Hall-Petch relation holds? (3)

(c) The number of vacancies per cubic meter at **800 °C** for a given metal is **1×10^{12}**. If the metal's activation energy is **0.9 eV**, determine the vacancy concentration at **1000 °C**. Use **$k = 8.617 \times 10^{-5}$ eV/K**. (3)

23221

Dr SSB, University Institue of Chemical Engineering & Technology

First Periodical, March 11, 2025

BE Chemical with MBA 2nd year, 4th Semester

Chemical Technology-II

Time: 90 mins **M:M-25**

Note: Attempt all Questions

1. Explain the extraction process of oil. Discuss the major engineering problem also. (7, CO_1)

2. What are the manufacturing processes of soap? Differentiate between soap and detergent. (6, CO_1)

3. Describe membrane processes. Explain electro dialysis process in detail. (6, CO_2)

4. Write about water softening process. Explain Ion exchange process in detail. (6, CO_2)

BE (Chemical)-MBA, Sem- 1st (MST-1)
Managerial Economics (MBA 102)

Max Marks : 25 **Max. Time: 90 minutes**

Note: All questions are compulsory.

1. Define:
   a. Law of demand
   b. Law of diminishing marginal utility
   c. Relationship between TR,MR and MR
   d. Delphi technique
   e. Demand elasticity (5 marks)

2. During a year of operation, a firm collects Rs.5,000,000 in revenue and spends Rs.3,500,000 on labor expense, raw materials, rent, and utilities. The firm's owner has provided Rs.1,000,000 of her own money instead of investing the money and earning a 12 percent annual rate of return. Find-
   a. The explicit costs of the firm
   b. The implicit costs
   c. Total economic cost
   d. Accounting profit of firm
   e. Economic profit of firm
   f. If the owner could earn 15 percent annually on the money she has invested in the firm, find the economic profit of the ,when revenue is $5,000,000.

OR

ABC Inc., makes a proprietary line of disposable surgical stapling instruments. The company grew rapidly during the 1990s as surgical stapling procedures continued to gain wider hospital acceptance as an alternative to manual suturing. However, price competition in the medical supplies industry is growing rapidly in the increasingly price-conscious new millennium. During the past year, ABC Inc sold 6 million units at a price of Rs.14.50, for total revenues of Rs.87 million. During the current year, ABC's unit sales have fallen from 6 million units to 3.6 million units following a competitor price cut from Rs.13.95 to Rs.10.85 per unit.

A. Calculate the arc cross price elasticity of demand for ABC's products.

B. ABC's director of marketing projects that unit sales will recover from 3.6 million units to 4.8 million units if it reduces its own price from Rs.14.50 to Rs.13.50 per unit. Calculate its implied arc price elasticity of demand.

C. Assuming the same implied arc price elasticity of demand calculated in part B, determine the further price reduction necessary for ABC to fully recover lost sales (i.e., regain a volume of 6 million units). (10 marks)

3. Discuss in detail the use of indifference curve analysis for determining the total price effect due to change in prices (10 marks)

23221

DR SSB UICET, PANJAB UNIVERSITY, CHANDIGARH

CLASS: B.E (Chem.)-MBA 2nd year **Periodical:1st** **Date:**

Sub:Strength of Material **Time: 90 mins** **Total Marks: 25**

Q.1 **2*5=10 Marks**

a) Discuss the difference between stress and pressure.

b) Write the difference between strain energy, resilience, proof resilience and toughness.

c) Discuss the concept of thermal stress.

d) Define poission ratio and factor of safety.

e) why we are studying S.O.M. Discuss its role in chemical engineering.

Q.2 Derive the relation between modulus of elasticity, modulus of rigidity and bulk modulus. 5 Marks

Q.3 At a point is strained the material the normal stresses are 60 N/mm² and 30 N/mm². Determine the resultant intensity of stress on a plane inclined at 40 degrees to the plane of minor stress. 5 Marks

Q.4 A simply supported beam 6m long is carrying a U.D.L of 5KN/m over a length of 3m from the right end. Draw SF and BM diagram. Also calculate the maximum bending moment. 5 Marks

Heat Transfer

BE (Chemical with MBA), BE(FT) 2nd Year (4th Semester)

Time: 1.5 hours **Max marks: 25**

Missing data, if any, may be assumed with proper justification.

Q. No.	Problem statement	Marks, CO
1	Derive an expression for temperature distribution in a cylinder of radius R in radial direction with uniformly distributed heat source.	3 CO1
2	A wall 2 cm thick is to be constructed from a material which has an average thermal conductivity of 1.3 $W/m^2.K$. The wall is to be insulated with material having thermal conductivity of 0.35 $W/m^2.K$, so that heat loss/m^2 will not exceed 1830 W. Assuming that the inner and outer surface temperatures of the insulated wall are 1300 and 30°C, determine the thickness of the insulation required.	5 CO1
3	A steel tube having k = 46 W/m.K has an inside diameter of 3 cm and tube wall thickness of 2 mm. A fluid flows on the inside of the tube producing a convection coefficient of 1500 $W/m^2.K$ on the inside surface., while a second fluid flows outside the tube producing a convection coefficient of 197 $W/m^2.K$, on the outside tube surface. The inside fluid temperature is 223°C while the outside fluid temperature is 57°C. Calculate the heat lost by the tube per meter of length.	5 CO1, CO2
4	Derive the expression for temperature distribution and rate of heat transfer from a very long circular rod fin protruding from a flat wall maintained at a constant temperature.	3 CO1
5	In a fully developed flow in a tube under turbulent conditions, heat transfer coefficient 'h' is function of the following variables: $h = f(\rho, c_p, \mu, k, v, D)$, where ρ is the density, c_p is specific heat, μ is viscosity, k is thermal conductivity, v is velocity, D is diameter of pipe. Using Dimensional analysis, show that for a fluid flowing in a tube under turbulent conditons, Nu = f(Re, Pr).	4 CO2
6	A 2.0 cm diameter tube is maintained at a constant wall temperature of 90°C. Water enters the tube at 40°C and leaves at 60°C. If the entering velocity is 3 m/s, calculate the length of the tube necessary to accomplish the heating. Following fluid properties data is given:	5 CO2

T (°C)	Dynamic viscosity (mPa s)	C_p (kJ/kg K)	k (W/m K)
40	0.653	4.18	0.6178
50	0.547	4.18	0.6305
60	0.466	4.18	0.641
70	0.404	4.18	0.6495
80	0.354	4.18	0.6562
90	0.315	4.18	0.6613

Use Seider and Tate's equation.

Dr SSB UICET, Second Periodical, 25th April, 2025

BE Chemical with MBA 2nd year, 4th Semester

Chemical Technology (Organic)

Time: 90 mins **M:M-25**

Note: Attempt all Questions

1. Explain the Kraft process with neat and clean flow sheet. (8, CO_3)

2. Explain sugar manufacturing process with neat flow sheet. (8, CO_3)

3. What is degree of Polymerisation? Write the classification of polymers in detail. (4, CO_4)

4. Write the composition of crude oil. Also differentiate between Thermal cracking and catalytic cracking? (5, CO_4)

Heat Transfer

BE (Chemical with MBA), BE(FT) 2nd Year

Time allowed: 1.5 h **M.M. 25**

Data may be assumed in case of missing data, with justification.

Q. No.	Problem Statement	Marks	CO
1.	Differentiate between subcooled boiling and pool boiling. Explain the different regimes of boiling when a platinum wire is submerged in a pool of saturated water for heating.	5	CO3
2.	A flat vertical plate is exposed to saturated vapours. The plate is maintained at a lower temperature than the saturated temperature of vapours. Derive the expression for average heat transfer coefficient for condensation of vapours on a vertical plate, using Nusselt analysis.	5	CO3
3.	A concentric tube heat exchanger uses water, which is available at 15°C, to cool ethylene glycol flowing inside the tube, from 100°C to 60°C. The water and glycol flow rates are each 0.5 kg/s. Determine the maximum possible heat transfer rate and effectiveness of the exchanger. Which is preferred, a parallel –flow or counter flow mode of operation? Given: At 80°C, $c_{p,EG} = 2.65 kJ/kg.K$	5	CO4
4.	Water with a flow rate of 0.05 kg/s enters an automobile radiator at 400 K and leaves at 330 K. The water is cooled by air in cross flow which enters at 0.75 kg/s and 300 K. If the overall heat transfer coefficient is 200 W/m^2.K, what is the required heat transfer surface area? If there is a need for applying correction factor F, it may be applied to counter flow $(\Delta T)_{lm}$. Given, F = 0.95. $c_{p,water} = 4.21 kJ/kg.K$ $c_{p,air} = 1.005\ kJ/kg.K$	5	CO4
5.	It is desired to concentrate 5000 kg/hr of a solution of sodium hydroxide from 10% to 25% solids in a single effect evaporator. Steam is available at 110°C and the vapour space is maintained at 410 mm of Hg. The boiling point of water corresponding to the vapour space is 84°C. The solution has a boiling point elevation of 10°C. The enthalpies of the feed and thick liquor are 90 and 80 kcal/kg respectively and the enthalpy of vapour is 650 kcal/kg. The feed enters at its boiling point corresponding to the vapour space pressure. Latent heat of steam, λ_s=534 kcal/kg. Calculate (a) the steam consumption per hour (b) If the available heat transfer area is 35 m^2, estimate the heat transfer coefficient (c) Determine the evaporator capacity and economy.	5	CO3

Attempt All.

Q.1 (3x5)

(a) Compare the microstructural outcome of slow vs. rapid cooling in the eutectoid region of the Fe–Fe_3C system.

(b) Define the nose of a TTT diagram. What is its practical implication during heat treatment of steels?

(c) How does strain rate sensitivity impact the creep performance of engineering alloys?

(d) State two advantages of using nonferrous alloys in heat exchanger construction. Support with examples.

(e) Explain the concept of fracture toughness (K_{IC}) and its role in designing aircraft or pressure vessels.

Q.2

(a) A Cu–Ni alloy of 40 wt% Ni is held at a temperature where the phase diagram indicates $\alpha = 65\%$ Ni and $L = 30\%$ Ni. (4)

Using the lever rule, calculate: (i) Fraction of solid α, (ii) Fraction of liquid, Also, interpret how these fractions will influence the resulting microstructure.

(b) A steel specimen is subjected to a creep test at 800 K and 150 MPa, resulting in a steady-state strain rate of 1.2×10^{-5} s^{-1}. Calculate the total strain after 5 hours. Also, interpret the implications for long-term use in boilers. (4)

(c) During a Brinell hardness test, an impression diameter of 3.8 mm is left by a 10 mm steel ball under a load of 3000 kgf. Calculate the Brinell Hardness Number (BHN). (4)

Use:

$$BHN = \frac{2P}{\pi D\left(D - \sqrt{D^2 - d^2}\right)}$$

where P= load, D= ball diameter, d= impression diameter.

(d) An alloy is cooled slowly through a peritectic point. Draw the cooling curve and label the reaction. Calculate phase fractions if given Cα=30%, Cβ=60%, and alloy =50%. (3)

BE(Chemical)-MBA, Semester-4th
2nd Periodical
Managerial Economics **Max Marks : 25**

Time : 1 hr 30 mins

Note: All questions are compulsory and carry equal marks

1. Can a firm under perfect completion operate in the short run when it is making losses? If so, under what conditions?
2. What is monopoly? Explain three conditions necessary for the existence of monopoly.
3. How does the price-output equilibrium under monopolistic competition is determined in short-run?
4. Explain the price leadership model of oligopoly.
5. Define price discrimination. Under what conditions can a monopolist discriminate between different buyers in fixing the price of his product? Under what conditions price discrimination is possible.

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Dr SSB University Institute of Chemical Engineering

Perodical:2nd

Sub: Strength of Materials

Class: B.E-Chem. (MBA) 2nd Year

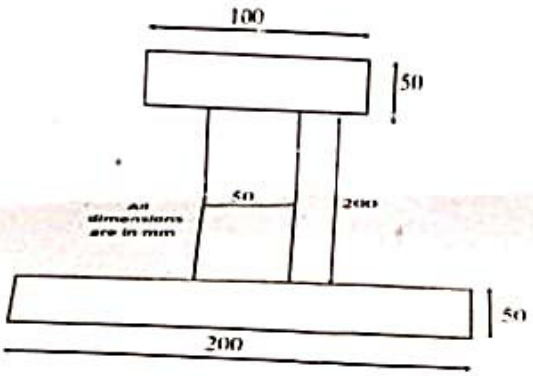
Max Marks: 25

Q.1

(a) - Derive the relations between circumferential and longitudinal stresses in thin shells. A thin cylindrical shell of 400 mm diameter is to be designed for an internal pressure of 3 MPa. Determine the suitable thickness of shell if the allowable hoop stress is 60 MPa. 8 Marks

(b) Write the Rankine formula for the column. 2 Marks

Q.2 In the I-section beam as shown below, if the maximum bending stress does not exceed 50MPa, find the moment that the beam can resist. 7.5 Markes



Q.3 (a) Write a note on Maximum Principal Stress theory and the Maximum Principal Strain theory of failure. 5 Marks

(b) Define spring and describe its types. 2.5 Marks

BE (Chemical)-MBA, Sem: 4th

Production & Operations Management (2nd periodical) **Max Marks : 25**

Time: 1 hour

Note: All questions are compulsory.

1. A bookseller buys 2500 copies of book operations management every year. The ordering cost is Rs.1000 per order. The carrying cost is 5% of the inventory value. The price of one copy of the book is Rs.400. The publisher of the book offers 1% discount if purchases are made in lots of 1,250 or more. Should the bookseller opt for the discount option or follow the EOQ Model? [10]
2. Define the purpose, objective and scope of value engineering. Illustrate your answer with examples. [10]
3. What is meant by the capacity of a facility? Explain different types of Capacity of a facility. [5]