UNIVERSITY OF PUNE

[4363]-241

T. E. (Polymer)-Backlog

Polymer Chemistry-I

(2008 Pattern)

Total No. of Questions : 12 **[Total No. of Printed Pages :4]**

[Time : 3 Hours] **[Max. Marks : 100]**

Instructions :

(1) Answer to Section-I and section-II should be written on separate answer book.

(2) Solve 3 questions from Section-I and 3 questions from Section-II.

(3) Neat diagram must be drawn wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of electronic pocket calculator is allowed.

SECTION-I

Q1.

a) With suitable examples explain the concept of functionality. Also comment on its importance in polymer field, and how does it affect the properties of polymer? [8]

b) What do you understand by the term molecular weight distribution (MWD)? Explain in brief any one method to determine MWD. [8]

OR

Q2.

a) Why, unlike other materials, polymeric materials have average molecular weights? [3]

b) Explain in detail the solution viscometry technique used to find out viscosity average molecular weight. [8]

c) A polydisperse sample of polystyrene was prepared by mixing three monodisperse samples in following proportions-

1 gm : 10,000 molecular weight
2 gm : 50,000 molecular weight
3 gm : 1,00,000 molecular weight
Calculate the number average- and weight average- molecular weights from using data [5]

Q3.

a) Explain in detail free radical polymerization mechanism including various steps involved in it. [8]
b) Write a short note on Emulsion Polymerization technique alongwith its advantages and disadvantages. [8]

OR

Q4.

a) Explain in brief solid-state polymerization. [5]
b) Enlist the types of ionic polymerization mechanism. Explain any one in detail. [8]
c) What are Inhibitors? Explain their role in polymer field. [3]

Q5.

a) With suitable example explain Ring Opening polymerization. [9]
b) Write short note on importance of Carother's equation used in condensation Polymerization. [9]

OR

Q6.

a) Discuss in detail the kinetics of stepwise (condensation) polymerization with the help of suitable example. [10]
b) Comment on distinguishing features of chain and stepwise polymerizations. [8]

SECTION-II

Q7.

a) Explain the difference between homo-and co-polymer. [2]
b) Discuss about necessity of preparing copolymer. [3]
c) Enlist three commercially important copolymers and their applications. [3]
d) Explain in detail the synthesis of block and graft copolymers. [8]

OR

Q8.

a) Briefly explain the classification of copolymers. [4]
b) What do you understand by reactivity ratio concept used in copolymers? Explain its significance in copolymerization reaction. [6]
c) Write short note on Use of copolymer composition equation used in copolymerization studies. Write the assumptions involved in equation. [6]

Q9.

a) Comment about necessity of carrying out modification of polymers. [4]
b) With suitable examples briefly explain the aminolysis and hydrogenation reactions used in polymers. [8]
c) Write any two modification reactions based on specific group present in polymer. [4]

OR

Q10.

a) What are various mechanisms of polymer degradation? Explain any one in detail. [10]
b) Write short note on Addition and substitution reactions used for polymer modification. [6]

Q11.

a) Explain in detail the monometallic and bimetallic mechanisms. [9]
b) Write short note on Ziegler-Natta polymerization. [9]

OR

Q12.

a) Explain the usage of Metallocene catalyst in polymerization. [9]
b) Write short note on various Isomerism in Polymers. [9]

UNIVERSITY OF PUNE

[4363]-244

T. E. (Polymer Engg)

Design of Equipment & Machine Elements

(2008 Course)

Total No. of Questions : 12 **[Total No. of Printed Pages :5]**

[Time : 3 Hours] **[Max. Marks : 100]**

Instructions :

(1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 OR Q.6 From section-I and Q.7 or Q.8, Q.9 or Q.10, Q.11 or Q.12 from Section-II.

*(2) Answers to the **two sections** should be written in **separate answer-books**.*

(3) Figures to the right indicate full marks.

(4) Use of pocket calculator and graph papers etc is allowed.

(5) Assume suitable data, if necessary.

SECTION-I

Q1.

a) Draw a neat sketch of sleeve coupling. Explain the design procedure for the different elements of the coupling. [8]

b) Write short note on copper and its alloys. [6]

c) Explain the basic design principle of design of flexible bushed pin coupling. [4]

OR

Q2.

a) Draw neat sketches of protective and unprotective type flanged couplings. Give standard design proportions. [7]

b) At a point in strained material, the intensities of normal stress on two planes at right angles to each other are 120 MPa, one compressive and other tensile. They are accompanied by shear stress of 50 MPa. Find maximum and minimum principle stresses and maximum shear stress using Mohr circle.[7]

c) Draw a neat sketch of Marine type of coupling and explain design procedure [4]

Q3.

a) Derive an expression for length of cross belt drive [5]
b) Compare flat belt drive, V-belt drive, and rope drive [5]
c) Derive an expression for diameter of shaft subjected to combined bending and twisting moment [6]

OR

Q4.

a) A hollow steel shaft transmits 650 kw at 400 rpm. Maximum permissible shear stress for the shaft material is 65 MPa. Find outside and inside diameter of the hollow shaft if outside diameter is twice inside diameter. Assume maximum torque is 30% greater than mean torque. [6]
b) A mild steel shaft is required to transmit 20 kw at 800 rpm. The supported length of shaft on bearing is 4 meter. It carries two pulleys each weighing 600Nsupported at a distance of 1meter from left hand bearing and 2 meter from right hand bearing respectively. Taking allowable shear stress of shaft as 60 N/mm^2, determine shaft diameter. [10]

Q5.

a) A machine spindle is to operate on aluminium metal at 40 meters per minute and is required to have six speeds. The spindle can accommodate cutters from 0mm to 60mm diameter. Determine spindle speeds. [3]
b) Explain with neat sketch [6]
   1) Spur gear drive
   2) Bevel gear drive
c) Draw a neat sketch and explain sliding gear arrangement for obtaining multiple spindle speeds. [4]
d) Draw a neat sketch of Plummer Block and explain its use [3]

OR

Q6.

a) A motor shaft of 200 mm diameter running at 1500 rpm generates a load of 150 kN, calculate
   1) Length of journal bearing if allowable bearing pressure is $2N/mm^2$
   2) Amount of heat generated if viscosity of oil at 60°C is 0.05 Kg/m-su and diamelral clearance is 0.3 mm. [4]

b) Write short notes on –
   1) Types of ball bearings
   2) Types of roller bearings
   3) Life of bearing. [12]

Section II

Q7.

a) With reference to injection moulding machine operations and cycle, explain how use of fixed displacement multiple pumps result in energy losses. [5]
b) Write short note on classes and types of hydromotors [5]
c) Draw a neat sketch and explain operation of any one type of pilot operated check valve. [4]
d) Explain simple basic regenerative hydraulic circuit. [4]

OR

Q8.

a) Draw a neat hydraulic circuit and explain the functioning of two pump unloading circuit. [5]
b) Draw neat sketch and explain single acting and double acting hydraulic intensifiers. [4]
c) Draw a neat hydraulic circuit for bi-directional rotation of hydraulics [4]
d) Draw a neat sketch of sequencing valve and explain the functioning. Draw also a hydraulic circuit explaining the use of sequence valve. [5]

Q9.

a) Explain the merits of all electric injection moulding machine over conventional hydraulic and hydro-mechanical injection moulding machines. [4]

b) Write merits of toggle type of injection moulding machines over conventional hydraulics machines. [4]

c) List various injection moulding machine operation & explain each in short Draw representative cycle time chart. [4]

d) Explain in short y on r understanding about proportional and digital hydraulics. [4]

OR

Q10.

a) Compare toggle, conventional hydraulic with lock and block type of injection moulding machine [4]

b) Draw and explain plasticizing hydraulic circuit with back pressure control. [7]

c) Explain with neat sketches and hydraulics circuit tonnage decompression operation with reference to direct hydraulic locking injection moulding machines. [5]

Q11.

a) List the various types of heads used in pressure vessels. Describe any two with neat figures. State the relevant design formulae for the same. [10]

b) A hemispherical head with 700 mm diameter is subjected to an internal pressure of 200 kg/cm^2. Calculate the required thickness of the head. Consider joint efficiency to be100%. [6]

OR

Q12.

a) A pressure vessel is 1 meter in diameter and operates at an internal pressure of 12 kg/cm^2. And is subjected to combined loading. Allowable stress for the material of construction is 980 kg/cm^2. Welded of vessel and is 80%. Weight

of vessel and its contents equal to 5000 kg. torque entered on the vessel is 50 kg-cm. corrosion allowance is 1mm. calculate the various stress induced in the pressure vessel. Verify whether equivalent stress is less than the permissible stress. [10]

b) Write short notes on (any one)
   1) Nozzle reinforcement procedure
   2) Support for vessels [6]

[Total No. of Questions: *12*] **[Total No. of Printed Pages:** *3*]

UNIVERSITY OF PUNE

[4363]-249

T. E. (*Polymer*) Examination - 2013

Polymer Processing Operations-I (2008 Course)

[Time: *3* **Hours]** **[Max. Marks: 100]**

Instructions:

1. ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6 from Section I. Answer Q7 or Q8, Q9 or Q10, Q11 or Q12 from Section II***
2. *Answers to the* ***two sections*** *should be written in* ***separate answer-books****.*
3. *Figures to the right indicate full marks.*
4. *Use of pocket calculator and graph paper is allowed.*
5. *Assume suitable data, if necessary.*

SECTION -I

Q.1	A	Explain extruder-die characteristics with a neat sketch. Explain how it can be used at shop floor level.	6
	B	With neat sketches describe various hopper and feed throat designs. Analyze flow through the hopper.	6
	C	Explain the cause for higher temperature at the central portion of the screw channel as compared to temperature near the barrel and screw surface.	6

OR

Q.2	A	Explain the effect of helix angle and channel depth in case of a single screw extruder.	5
	B	For a single flighted screw, following data is available: (i) Channel depth = 3mm (ii) Screw diameter = 75mm (iii) Screw speed = 100rpm (iv) Helix angle = 17 degree (v) Viscosity of the polymer = 300=Ns/m^2 Find volumetric flow rate due to drag flow.	6
	C	Explain the general features of a barrier screw and with the help of development view, explain the constructional features of barrier section.	7
Q. 3	A	What are calibrators. Discuss with neat sketches, different types of calibrators used for rigid and semi-rigid tubes.	8
	B	With neat sketches, discuss straight through and offset dies used for pipe extrusion.	8

OR

Q. 4	A	Explain with the help of neat sketch, wire coating line.	8
	B	With a neat sketch, explain the caterpillar haul off system used.	8
Q. 5	A	Discuss special features of processing of rigid PVC injection molding and discuss machine features with reference to molding of pipe fittings.	5
	B	Give generalized processing recommendations for i) Cellulose acetate ii) Polypropylene iii) ABS	6
	C	Draw neat sketches for at least two design of nozzles used in thermoplastic injection molding.	5

OR

Q. 6	A	Draw PVT diagrams for crystalline and amorphous materials. Superimpose injection molding cycle and explain how this can be used for process control and dimensional accuracy.	6
	B	Discuss fill (velocity) and hold on (pressure) phase in injection molding and also explain the cavity pressure profile and hydraulic pressure profile.	6
	C	Discuss following injection molding problems i) Sink marks, voids ii) Splash marks, mica marks	4

SECTION II

Q. 7	A	Explain the process of thermoset injection molding with respect to i) Design of screw and barrel ii) Design of nozzle iii) Barrel temperature control iv) Runner and gate design	8
	B	Explain slush molding and dip coating techniques.	10

OR

Q. 8	A	Explain various methods of achieving low pressure in low pressure injection molding.	6
	B	Draw a schematic step wise sketch of process of gas assisted injection molding and explain the process in short.	6
	C	Explain any one method of two color two component injection molding process.	6

Q. 9	A	Discuss the three extruder system to make corrugated core sandwich panel. Draw a sketch of the die used for extrusion of corrugated core sandwich panel	8
	B	Explain the constructional features of the extrusion die for making of netting.	4
	C	Explain with neat sketches coil and cut off unit for coiled extrusions.	4
		OR	
Q. 10	A	Explain with neat sketch, in-line corrugate unit.	4
	B	Write a note on dies for extrusion of cellular products.	6
	C	Write a note on twisted rod extrusion.	6
Q. 11	A	Discuss the two common methods of transfer molding. State advantages and disadvantages of transfer molding process.	8
	B	Compare compression, transfer and injection molding of Dough Molding Compounds.	8
		OR	
Q. 12	A	Discuss advantages and disadvantages of compression molding process.	8
	B	Explain the application of flow cure curves for process control in transfer and compression molding.	8

UNIVERSITY OF PUNE

[2363]-245

T. E. (Polymer Engineering)
Examination - 2013

Mass Transfer & Reaction Engineering
(2008 Pattern)

[Time : 3 Hours] **[Max. Marks : 100]**

Total No. of Questions : 12 **[Total No. of Printed Pages :4]**

Instructions :

*(1) Answers to the **two sections** should be written in **separate answer-books**.*
(2) Use if logarithmic table, electronics pocket calculator is allowed
(3) Number to the right indicate full marks.
(4) Neat diagrams must be drawn wherever necessary.
(5) Assume suitable data, if necessary.

SECTION I

Q.1] a) Write short note in Analogies between Heat and Mass Transfer. [6]

b) Oxygen (A) is diffusing through Carbon monoxide (B) under steady state condition, with the carbon monoxide as non-diffusing. The total pressure is 1 x 10^5 N/ m^2 and temperature 0 $^oC_2$. The partial pressure of oxygen at two planes 2 mm apart is 13000 N/ m^2 and 6500 N/ m^2 respectively. The diffusivity for the mixture is (D_{A-B}) = 1.87 x10^{-5} m^2/sec. Find the rate of diffusion of oxygen through each square meter the two planes. [6]

c) Write a note on steady state diffusion in Multi – component mixtures. [6]

OR

Q.2] a) Water in bottom of tube is held at a constant temperature of 293^0 K. The total pressure 1.0 atm pressure .Water evaporates and diffuses through the non diffusing Air. Assume length of diffusion path is 0.1524 m. Calculate the rate of evaporation at steady state. Diffusivity of water is 0.25 x 10^{-4} m^2/sec at given condition. Vapor pressure of water is 0.0231 atm. [9]

b) Explain necessary expressions for Molecular diffusion in Liquids under Steady State diffusion of A through non-diffusion B and Equimolar counter diffusion. [9]

Q.3] a) Write a note on "Choice of solvent" for gas Absorption. [8]

b) Differentiate between Tray tower and Packed tower. [8]

OR

Q.4] a) Write note on minimum liquid to gas ratio for gas absorber. [8]

b) Write note on [8]

(i) Liquid – Liquid extraction

(ii) Simple Distillation

Q.5] a) Discuss the following terms :

Absolute Humidity , Relative Humidity, Saturation Humidity, Percentage Humidity, Humid Heat , Humid Volume , Total Enthalpy of Air –Water vapor Mixture , Adiabatic Saturation temperature , Dew Point, Wet Bulb and Dry Bulb temperature, Moisture content. [16]

OR

Q.6] a) Batch of wet solid is to be dried from free moisture content X_1 = 0.48 kg H_2O/kg Dry solid to X_2 = 0.04 kg H_2O/kg Dry solid. Weight of dry solid = 399 kg and area = 18.58 m^2. Find the total drying time. [12]

X (Free Moisture content)	0.195	0.150	0.10	0.65	0.05	0.04
R (Drying rate)	1.51	1.21	0.9	0.71	0.37	0.27

b) Explain the terms such as moisture content, Equilibrium moisture, Free moisture, Bound and unbound moisture content, Critical moisture content. [4]

SECTION II

Q.7] a) Discuss the followings :

Order , Molecularity , Rate Constant and Temperature Dependency of rate of reaction. [12]

b) Explain the importance of reaction engineering in chemical industry. [4]

OR

Q.8] a) Discuss different parameters affecting rate of reaction. [8]

b) Write a short note on classification of chemical reactions useful for the reactor design. [8]

Q.9] a) Differentiate between Integral and Differential Method of analysis of Reactor. [6]

b) Discuss the integral method of analysis of kinetics of constant volume batch reactor. [12]

OR

Q.10] a) Discuss Half Life method to determine overall order of reaction. [9]

b) Discuss the differential method of analysis of kinetics of constant volume batch reactor. [9]

Q.11] a) A stream of gaseous reactant A with C_{Ao} = 660 mole / lit enters a plug flow reactor at a molar flow rate of 540 mole /min and polymerizes as per following reaction 3A → R and –rA = $54C_A$, find the size of reactor required to lower the concentration of A in the exit stream to C_{Af} = 330 mole / lit. [8]

b) Write different factor to be considered while designing of polymer reactors. [8]

OR

Q.12] a) Write a short note on different types of reactor is series. [8]

b) Compare the sizes of PFR and MFR for first order reaction in detail. [8]

UNIVERSITY OF PUNE
[4363-242]
T.E. (Polymer) Examination-2013
Polymer Materials
(2008 pattern)

Time-Three hours Maximum Marks-100
Total No. of Question=12 [Total no. of printed pages= 4]
Instructions:

(1)Answer 3 questions from Section-I. Answer question 3 from Section-II,
(2)Answers to the two sections should be written in separate answer books.
(3)Neat diagrams must be drawn whenever necessary.
(4)Figures to the right indicate full marks.
(5)All question carry equal marks.
(6)Assume suitable data wherever necessary.
(7)Use of logarithmic tables,slide-rule,mollier charts,,calculator and steam tables is allowed.

SECTION-I

Q.1

(a)Differentiate between commodity engineering and high performance polymers.Give two examples of each type. (5)

(b)Discuss UHMHDPE with respect to properties processing and applications. (5)

(c)Discuss the points to be borne in mind while processing polyethylene. (4)

(d)Give two properties & applications of polyvinylalcohol and polyvinylacotate. (4)

OR

Q.2

(a)Discuss the procedure for manifacture of polyvinylalcohol. Why is it not synthesized by the polymerisation of vinyalcohol? (5)

(b)Why is polypropylene times manufactured by the downward tabular quench extrusion method?Explain the process with a neat sketch. (5)

(c)Discuss the different grades of polyvinylalcohol. (4)

(d)Classify the following as commodities,engineering and high performance polymers. (4)

(i)Polyvinylidence dichloide.
(ii)HIPS
(iii)PTFE
(iv)Celluloxics
(v)PVDF
(vi)LLDPE

Q.3

(a)Discuss the various modified forms of Polyshyrene. (6)

(b)Discuss the need for addition mechanism of functioning ,level of addition and two examples of the following additives with respect to PVC. (8)
(i)Lubricants (ii)Antioxidents

(c)Give two applications of PTFE. (2)

OR

Q.4

(a)Differentiate between plastisols and organosolo. (4)

(b)Explain the steps involved in the manufacture of expanded polystyrene. (5)

(c)Give two outstanding properties and the applications of polyvinylidence fluoride. (4)

(d)Explain the role of a plasticiser in processing of PVC. (3)

Q.5

(a)What is the need for preparation of a prepolymer method of preparation of a prepolymer with respect to PMMA sheet manufacturing.How are PMMMA sheets manufactured? (6)

(b)State two applications in which a transparent polymer is used.State the transparent polymer is used in the same. (4)

(c)Discuss the general points to be borne in mind when processing the PMMA.(6)

OR

Q.6

(a)Discuss the four possible routes for manufacture of polycarbonate. (6)

(b)Discuss processing of Polycarbonate. (6)

(c)State four outstanding properties of Cellulose acetate. (4)

SECTION-II

Q.7

(a)Give basic recipe for making a point.State the role of each ingredient. (6)

(b)Discuss the various points to be borne in mind while choosing a solvent for a point. Give two examples of solvents used for points. (5)

(c)How do points differ from stains,varnishes and lacquers? (4)

(d)What is the role of primers with respect to points?Give examples of the same. (3)

OR

Q.8

(a)List the various types of adhesives and give two examples of each type. (6)

(b)What is the role of thickening agents with respect to adhesives?Give two examples of the thickening agents. (4)

(c)Discuss therodynamics with respect to adhesives. (5)

(d)What are antishinning agents used with respect to the paints?Give one example. (3)

Q.9

(a)What are the structural requirements for a material to lea rubber? (4)

(b)Discuss the various steps involved in row rubber technology.Draw a neat flow chart to show the steps. (6)

(c)What is mastication/discuss matxication of natural rubber? (6)

OR

Q.10

(a)Give a formulation for a rubber base.State the role of each ingredient used.(4)

(b)State the various steps involved in converting rubber latex to a finished product. (6)

(c)What is valcanisation?State the various types of vulcansing agents used with respect to Natural rubber.What is the role of vulcanisation? (6)

Q.11

(a)Write a short note on “thermoplastic elastomers”. (6)

(b)Give the rubber used in the following application. (4)

(i)LPG Tube (ii)tyre treads

(iii)Conveyor belts (iv)tyre tubes.

(c)Give two properties and two applications of the following rubbers. (6)

(i)Nitrile rubber (iii)butyl rubber

(ii)SBR

OR

Q.12

(a)Write the structure of the following rubbers. (5)

(i)Butyl rubber

(ii)Nitrile rubber

(iii)SBR

(iv)Natural rubber

(v)polychloroprene rubber

(b)State the different types of SBR.Differentiate between them. (6)

(c)Write a short note on compounding of Natural rubber. (5)

UNIVERSITY OF PUNE

[4363-243]

T.E.(Polymer) Examination May 2013

Polymer Structure Property Relationship

(2008 pattern)

Time-Three hours **Maximum Marks-100**

[Total No. of Question=12] **[Total no. of printed pages= 4]**

Instructions:

(1)Answer 3 questions from section I and 3 questions from section II.

(2)Answer to the TWO sections should be written in separate answer books

(3)Neat diagrams must be drawn whenever necessary.

(4)Figures to the right indicate full marks.

(5)Your answer will be valued as whole.

(6)Assume suitable data whenever necessary.

SECTION-I

Q.1 (a)Give the effect of bonds formed by carbon atom on various polymer properties like mechanical,chemical,thermal and electrical. (8)

(b)Explain the rule of various additives on polymer properties with examples. (10)

OR

Q.2 (a)Why Nylon in hygroscopic material? (3)

(b)Why PP melt of higher tempetine than HDPE? (3)

(c)Why presence of halogen make a polymer self-extinguishable. (3)

(d)What is an isocynate linkage? (2)

(e) what leads to chaining of polymer (2)

(f)What leads to chaining oxygen atom makes when present in a polymer & it effect. (5)

Q.3 (a)Give the effect of molculan size and shape on polymer properties with examples. (8)

(b)What is meant by M_w, M_n and polydispensity & their role in influencing polymer properties. (8)

OR

Q.4 (a)Explain any two conversion methods used to convert from low to high molecular wright during processing. (6)

(b)During blow molding.What type of M.w & M WD is required and why. (4)

(c)Explain plot of impact strength v/s MF1 to show effect of HDPE with NMWD and BMWD having density 0.95 and 0.96 gm/cc. (6)

Q.5 (a)Why molecular flexibility in important in polymer.Explain with examples. (6)

(b)Explain potential energy barrier. (6)

(c)Explain what is meant by super cooled state & how does it affect the morphology. (4)

OR

Q.6 (a)Explain fringed micelle model & how it was used to understand the internal morphology in polymer. Also explain how growth of sphemlite taken place & their effect on properties. (8)

(b)What are the chemical groups whose presence helps to enhance adhesion.(4)

(c)Why is it necessary to know the structure & property thus possessed by any polymer? (4)

SECTION-II

Q.7 (a)Why different properties are shown by syndiotatic atatic & isotactic PP? (6)

(b)Explain role of plasticiser on polymer properties & when does it act as an antiplasticiser. (6)

(c)Plot a graph of modulers v/s temperature for glany.cyrtalline and x-linked polymer. (3)

(d)Explain solubility parameter & its importance. (3)

OR

Q.8 (a)What all facliers affect crystallization and also role played by nucleating agents. (9)

(b)Explain Thermodynamic & kinetic factors affecting crystallization. (9)

Q.9 (a)Explain the different types of Intermolecular forces present in polymers with examples. (12)

(b)Explain cohesive energy density? (4)

OR

Q.10 (a)Give effect of polarity on polymer properties. (5)

(b)What is ionic bonding? (4)

(c)What are labile bonds. (3)

(d)Give role of x linking and its effect on properties. (4)

Q.11 (a)Explain how temperory hetrogenity id required for processing with examples. (6)

(b)What is meant by chemical microhetrogenity. Explain with examples. (4)

(c)Write short note on foams. (6)

OR

Q.12 (a)Write a short note on blends. (5)

(b) Write a short note on laminates. (5)

(c) Write a short note on Membranes. (6)

UNIVERSITY OF PUNE
[4363]-246
T. E.(Polymer Engg.)Examination - 2013
MATHEMATICAL METHODS FOR POLYMER ENGINEERING
(2008 Pattern)

[Total No. of Questions:12] **[Total No. of Printed Pages :7]**
[Time : 3 Hours] **[Max. Marks : 100]**

Instructions :

*(1) Answer **Q1 or Q2, Q3 or Q4, Q5 or Q6** from section I and **Q7 or Q8, Q9 or Q10, Q11 or Q12** from section II.*
*(2) Answers to the **two sections** should be written in **separate answer-books**.*
(3) Black figures to the right indicate full marks.
(4) Neat diagrams must be drawn wherever necessary.
(5) Use of electronics pocket calculator is allowed.
(6) Assume suitable data, if necessary.

SECTION-I

Q1 a) Show that $\Delta = E\,\nabla = \nabla E = \delta E^{1/2}$ [3]

b) Construct the difference table from the following data obtain if(50.5) [8] and(53.4) using Newton's forward and backward difference formula respectively correct to 4 decimal place.

x	50	51	52	53	54
f(x)	39.1961	39.7981	40.3942	40.9843	41.5687

c) Evaluate $\int_2^6 \log_{10} x\, dx$ by using Simpson's $1/3$ rule taking n=6 [6]

OR

Q2 a) Apply Lagrange's interpolation formula to find a polynomial which [5]

passes through the points: (0,-20),(1,-12),(3,-20) and (4,-24).

b) Evaluate $\int_0^{\pi} \frac{\sin^2\theta \, d\theta}{5+4\cos\theta}$ by Simpson's $3/8^{th}$ rule taking h=$\pi/6$ [6]

c) Compute $\frac{dy}{dx}$ where y=f(x) at x=16 from the following table [6]

x	15	17	19	21	23	25
f(x)=$\sqrt{x}$	3.873	4.123	4.359	4.583	4.796	5.0

Q3 a) Find the root of the equation $4\sin x = e^x$ that lies between 0 and 0.5, [6] using Regula-Falsi method correct to 4 decimal places.

b) Solve the following system of equations, correct to two places of decimals, by Jacobils iteration method. [6]

30x-2y+3z=75

x+17y-2z=48

x+y+9z=15

c) Find a least square straight line for the following data [5]

X:	1	2	3	4	5	6
Y:	6	4	3	5	4	2

OR

Q4 a) Solve the system of equations by Guass-Seidal iteration method. [6]

83x+11y-4z=95

7x+52y+13z=104

3x+8y+29z=71

b) Find the root between 1 and 2 using Newton Raphson method [6]

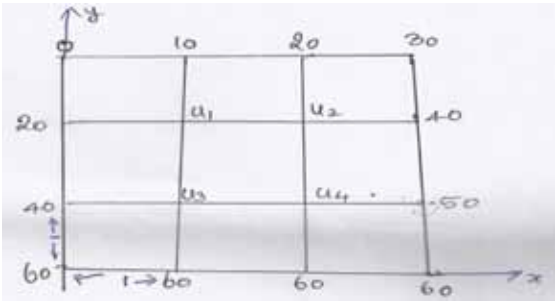
$3x^3-9x^2+8=0$

c) Using least square method, fit a second degree polynomial. Estimate Y at X=6.5 [5]

X:	0	1	2	3	4	5	6	7	8
Y:	12.0	10.5	10.0	8.0	7.0	8.0	7.5	8.5	9.0

Q5 a) Solve $\frac{dy}{dx} = \sqrt{x^2 + y}$ using Runge-Kutta Fourth order method to find y at x =0.4 given y(0)=1, take h=0.2 [8]

b) Solve $\frac{\partial^2 y}{\partial x^2} + \frac{\partial^2 y}{\partial y^2} = 0$, correct to two places of decimals, at the nodal points of square grid using the boundary values indicated. [8]



OR

Q6 a) Use modified Euler's method to solve $\frac{dy}{dx} = x - y^2$, y(0)=1 to Calculate y(0.4) taking h=0.2 [8]

b) Solve the equation $\frac{\partial^2 y}{\partial x^2} + \frac{\partial^2 y}{\partial y^2} = -10(x^2 + y^2 + 10)$,over the square mesh with sides x=0, y=0, x=3,y=3 with u=0 on the boundary of mesh length 1. [8]

SECTION-II

Q7 a) Use simplex technique to solve the following Linear programming problem. [10]

Minimize $z = x_1 - 3x_2 + 2x_3$

Subject to $3x_1 - x_2 + 3x_3 \leq 7$

$-2\,x_1 + 4x_2 \leq 12$

$-4\,x_1 + 3x_2 + 8\,x_3 \leq 10$

And $x_1, x_2, x_3 \geq 0$

b) Write the Dual of the following LPP [6]

Maximize $z = 1600x_1 + 1500x_2$

subject to $5x_1 + 2x_2 \leq 600$

$3\,x_1 - 4x_2 \leq 100$

$4\,x_1 + 5x_2 \leq 200$

$x_1 + x_2 \leq 50$

Where $x_1, x_2 \geq 0$

OR

Q8 a) Use Simplex method to solve the following linear programming Problem [10]

Maximize $z = 3x_1 + 5x_2 + 4x_3$

subject to $2x_1 + 3x_2 \leq 8$

$2\,x_2 + 5x_3 \leq 10$

$3x_1 + 2x_2 + 4x_3 \leq 15$

and $x_1, x_2, x_3 \geq 0$

b) Write the Dual of the following LPP [6]

Maximize $z = 12x_1 + 26x_2 + 40x_3$

subject to $2x_1 + 6x_2 + 5x_3 \geq 4$

$4x_1 + 2x_2 + 2x_3 \geq 10$

$x_1 + x_2 + 2x_3 \geq 6$

and $x_1, x_2, x_3 \geq 0$

Q9 a) From a group of 10 students marks obtained by each in papers of [6]

Mathematics and Polymer chemistry are given as:

x Marks in Maths	23	28	42	17	26	35	29	37	16	46
y Marks in Polymer chemistry	25	22	38	21	27	39	24	32	18	44

Calculate coefficient of correlation.

b) On an average a box containing 10 articles is likely to have 2 [6]

defectives. If we consider a consignment of 100 boxes, how many of them are expected to have three or less defectives?

c) The demand for a particular spare part in a factory was found to vary [5]

from day to day. In a sample study the following information was obtained.

Days	Mon	Tues	Wed	Thurs	Fri	Sat
No. of parts demanded	1124	1125	1110	1120	1126	1115

Test the hypothesis that the number of parts demanded does not depend on The day of the week. $[\psi^2_{5;0.05} = 11.07]$

OR

Q10 a) Between 2 P.M. and 3 P.M. the average number of phone calls per [5]
minute coming into the company are 2. Find the probability that during are particular minute there will be (i) No phone calls at all (ii) 2 or less calls

b) Obtain regression lines for the following data [6]

x	2	3	5	7	9	10	12	15
y	2	5	8	10	12	14	15	16

c) For a Normal probability distribution with mean 4 and variance 16 [6]
find (i) P(x>5) ii) P(x<2) iii) P(6<x<8)

[z=0.25, A=0.0987, z=0.5, A=0.1915, z=1, A=0.3413]

Q11 a) If A_r^{pq} and B_r^{pq} are tensors, show that $A_r^{pq} + B_r^{pq}$ is also a tensor. [6]
Again if C_t^s is a tensor show that $A_r^{pq}\ C_t^s$ is also a tensor.

b) If A_p is a covariant tensor of rank one, show that $\frac{\partial A_p}{\partial x^q}$ is not a tensor. [5]

c) Determine conjugate metric tensor in cylindrical coordinates. What is [6]
the metric tensor in spherical polar coordinates?

OR

Q12 a) Let A_{rst}^{pq} be a tensor, choose p=t and show that A_{rsp}^{pq} where the [5]
summation convention is employed, is a tensor. What is its rank and type?

b) A covariant tensor has components x^2y, y^2z, xyz in three dimensional [6]
rectangular Cartesian coordinate system. Find its covariant components in cylindrical system.

c) With usual notation, show that [6]

i) [pq,r]=[qp,r], ii) $\left\{ {s \atop pq} \right\} = \left\{ {s \atop qp} \right\}$ iii) [pq,r]=$g_{rs} \left\{ {s \atop pq} \right\}$

[Total No. of Questions: *12*] **[Total No. of Printed Pages: 2]**

UNIVERSITY OF PUNE

[4363]-247

T. E. (*Polymer*) Examination - 2013

Polymer Chemistry-II (2008 Course)

[Time: *3* Hours] **[Max. Marks: 100]**

Instructions:

1. ***Answer 3 questions from Section I and 3 questions from Section II.***
2. *Answers to the **two sections** should be written in **separate answer-books**.*
3. *Black figures to the right indicate full marks.*
4. *Neat diagrams must be drawn wherever necessary.*
5. *Use of electronic pocket calculator is allowed.*
6. *Assume suitable data, if necessary.*

SECTION –I

Q.1	A	Which family of polymer Novolak and Resols belong to? Explain their synthesis.	9
	B	What are amino resins? Alongwith appropriate chemical reactions explain synthesis of any one resin.	9
		OR	
Q.2	A	Explain in detail various additives, and their role used in Phenolic resin.	9
	B	Write short note on Silicone Resins.	9
Q. 3	A	What are the raw materials used in synthesis of unsaturated polyester resin? Explain their role.	8
	B	What are saturated polyester resins? Enlist their properties and applications.	8
		OR	
Q. 4	A	Comment on properties and applications of unsaturated polyester resins.	8
	B	Explain in detail synthesis and properties of vinyl ester resins.	8
Q. 5	A	Write a short note on Rigid and Flexible Polyurethane Foams.	8
	B	What are Epoxy Equivalent and Epoxy Value? Explain their significance.	8

OR

Q. 6	A	Explain in details various curing systems used in cross-linking of epoxy resins.	10
	B	Write note on synthesis of polyurethane.	6

SECTION II

Q. 7	A	Compare properties of linear polyamides and polyacetals.	7
	B	What are polyimides ? Enlist properties and applications of polyimides.	9

OR

Q. 8	A	Why Nylons are hygroscopic? Between Nylon66 and Nylon610 which will be more hygroscopic? Justify your answer?	6
	B	Draw the repeating unit of ployacetals. Give manufacture of acetal homopolymer and copolymer.	7
	C	Why acetals should be processed below $270\ ^{0}$ C?	3
Q. 9	A	What are Polysulphones? Comment on various properties of polysulphones.	8
	B	Explain in detail manufacturing of Poly (phenylene sulphide).Enlist 2 applications.	8

OR

Q. 10	A	Give properties of poly (ether ether ketone).	6
	B	Explain in detail synthesis of poly (phenylene oxide).	7
	C	PEK/PEEK can be considered as High Performance polymers. Do you agree with statement? Justify your answer.	3
Q. 11	A	Explain in detail Use of Polymers in Drug Delivery.	9
	B	What are the Thermotropic and Lyotropic liquid crystalline polymers?	4
	C	Briefly explain Plasma Polymerization technique used in polymer synthesis.	5

OR

Q. 12	A	What are liquid crystalline polymers (LCPs)?Give 2 examples and their applications.	6
	B	Write short note on conducting Polymers.	9
	C	Explain the terms Biocompatible and Biodegradable polymers.	3

[Total No. of Questions: *12*] **[Total No. of Printed Pages:** *3*]

UNIVERSITY OF PUNE

[4363]-248

T. E. (*Polymer Engineering*) Examination - 2013

Instrumentation and Process Control

(2008 Course)(309368)

[Time: *3* **Hours]** **[Max. Marks: 100]**

Instructions:

1. *Answers to the* ***two sections*** *should be written in* ***separate answer-books****.*
2. *Black figures to the right indicate full marks.*
3. *Neat diagrams must be drawn wherever necessary.*
4. *Use of logarithmic tables, electronic pocket calculator is allowed.*
5. *Assume suitable data, if necessary.*

SECTION –I

Q.1 A A temperature transducer has a span of 20-250°C. A measurement results in a value of 55°C for the temperature. Specify the error if the accuracy is (i) ±0.5% full scale division, (ii) ±0.75% of span and (iii) ±0.8% of reading. What is the possible temperature in each case? [6]

B Discuss the following with one example: [6]
Primary Element, Signal Conditioner and Calibration.

C Explain the term error. What are the different types and sources of error? [6]

OR

Q.2 A A load cell is calibrated at a temperature of 20°C has the following output / input characteristics: [8]

Load in KN	0	0.4	0.8	1.2	1.6	2
Deflection of meter in mm	0	10	20	30	40	50

When it is used in an environment of 40°C, its characteristics change to the following

Load in KN	0	0.4	0.8	1.2	1.6	2
Deflection of meter in mm	3	14	25	36	47	58

Determine (i) Zero drift, (ii)Sensitivity drift, (iii) Sensitivity drift per °C change in ambient temperature, (iv) If 0.5 mm of scale division can be read with a fair degree of certainty, then determine

		resolution of instrument in both cases i.e. at 20°C and 40°C in KN	
	B	Explain the various Static and Dynamic Characteristics of measuring instruments	[10]
Q. 3	A	Explain in detail thermoelectric temperature measurements.	[10]
	B	What are different pressure scales? A mercury manometer has a float in left hand chamber. An electromechanical transducer is used to measure the motion of the fluid. The float motion is 5 mm for gauge pressure of 50KN/m^2. If a diameter of float chamber is 40mm, find the required diameter for right hand chamber. For mercury, density is 13600 kg/m^3. Assume that other end of manometer is open to the atmosphere.	[6]
		OR	
Q. 4	A	What are elastic element traducers to measure pressure and explain any one in detail. Also explain strain gauge in detail.	[10]
	B	Write ice point and steam point of different temperature scales. How much will an aluminum rod of 10m length at 20°C expand when temperature is changed from 0°C to 100°C?[expansion coefficient of 'Al' is 25* 10^{-6}/°C]	[6]
Q. 5	A	Explain in detail Air Purge and Ultrasonic liquid level system. Also states advantages and disadvantages of Air Purge and Ultrasonic level measurement systems.	[16]
		OR	
Q. 6	A	A pipe I.D. 7.5 cm is carrying water at 20°C. In this pipe a venturimeter is fitted which as throat diameter 2.0 cm. Manometer is installed in pipe reads 50 cm, what is the flow rate of water in the pipe. Density=1000kg/m^3 and Cv =0.98.	[8]
	B	Explain the importance of density measurement in polymer industry and suggest suitable instruments for doing so.	[8]
		SECTION II	
Q. 7	A	Derive applicable Transfer Equation for Single Liquid Level Tank System.	[10]
	B	A thermometer which is observed to exhibit the first order dynamics with time constant of 15 sec, which is placed in bath at temperature of 50°C and after reaching steady state, it is suddenly placed into hot water at 70°C. Find the response of the thermometer at time =5,10,15,20,25,30 sec.	[8]
		OR	
Q. 8	A	Explain in detail unit step Response of Non Interacting two-tank liquid level system.	[10]

	B	A second order system is observed to exhibit an Under damped response giving the Ultimate Value =26 and Minimum Value of the response =15. Find the overshoot and Maximum Value of the response for damping coefficient ξ=0.8,0.4,0.2,0.1.	[8]
Q. 9	A	Explain with standard block diagram for feedback control system and derive the necessary expression for overall closed loop Transfer function.	[10]
	B	If the Characteristics equation for give feedback loop control system is given by $2s^3+3s^2+(1+Kc)s+2Kc=0$. Determine the value of Gain which causes just Instability and also determine the location of pair of the roots for given control system.	[6]
		OR	
Q. 10	A	Discuss Pressure feedback control system with suitable components.	[8]
	B	Explain Proportional Control action.	[8]
Q. 11	A	Discuss with neat diagrams the modes of Integral (I), Derivative (D) Proportional- Integral (PI) control actions and explain the transient response of control system with Integral Control and Proportional-Integral Control for set point change.	[16]
		OR	
Q. 12	A	Explain the followings: i) Cascade Control of Liquid Level in a Tank (ii) Digital Control System	[16]

[Total No. of Questions: *12*] **[Total No. of Printed Pages:** *4*]

UNIVERSITY OF PUNE
[4363]-250
T.E. (Polymer Rheology) Examination - 2013
Polymer Rheology
(2008 Course)

[Time: *3* **Hours]** **[Max. Marks: 100]**

Instructions:

1. ***Answer*** *three questions from section I and three questions from section II.*
2. *Your answers will be valued as a whole.*
3. *Answers to the* ***two sections*** *should be written in* ***separate answer-books.***
4. *Neat diagrams must be drawn wherever necessary.*
5. *Assume suitable data, if necessary.*
6. *Use of logarithmic tables, slide rule, Mollier charts, electronics pocket calculator is allowed*
7. *Black figures to the right indicate full marks.*

SECTION -I

Q.1 A Explain creep compliance. [2]

B A tensile test piece of rubber having dimensions 3×6×20 mm was subjected to a tensile force of 100N and gave following data. Force was removed later to have instantaneous recovery. Calculate instantaneous compliance & compliance at 200 sec. [6]

Time (s)	0	10	50	100	200
Lenyth (mm)	50	75	100	115	120

C Why rectors cannot be used to define rheology. Also explain how tensors help in understanding rheology with an eg. [5]

D Explain following terns: [5]
1) Rheology 2) Flow 3) Weissenburg long effect
4) Melt fractune

OR

Q.2 A Explain thermal conductivity and diffusivity [2]

B Give canchys equation and explain the terms appearing in the equation [6]

C Derive continuity equation. [8]

D Give the stren and strain rate equation for capillary rheometer [2]

Q.3 A PE rod has Ø=6mm and l=40 at 100° is subjected to a sinusoidal force of ± 100 N at a frequency of 1 Hz. G^1= 0.084 pa and tans = .745 calculate : i) input stren and output strain [10]

ii) Max deformation in rod
iii) G" iv) J' and J"

B Give the diagram of the two elements when present in max well as well on Voigt model. Also mention the conditions in which each model satisfies the viscoelastic Natune. [6]

OR

Q. 4 A A rubber sample has elongation at break of 110% the stren strain curse in given by the equation $z(r) = 26.7\ r^{(0.85)}$ (stren in MPa) and its stren relaxation in given by $z(t) = Zo e^{-0.01t}$. the sample in subjected to following changes in strain at different time intervals : as shown below. Using BSP calculate strain at 100, cm,200 & 350 sec [10]

Time (sec)	T ≤0	0<t≤ 50	50<t≤150	150<t250	250>t≤300	300≤t
Strain ®	0	0.40	0.55	0.65	0.75	0.70
Stepin strain		+0.40	+0.15	+0.10	+0.10	-0.05

B Explain WLF equation with its significance [6]

Q. 5 A Give the effect of M.W and shear rate on melt insecurity [5]

B Explain temperature dependency of insecurity [5]

C Explain the effect of plasticizer & × linlcing on palmer morphology & tune viscosity [6]

OR

Q. 6 A Effect of presume on viscosity is inversely proportional to that of temperate on viscosity justify [6]

B What is of significance critical mole molecular weight Give the effect of NMWD and BMWD on viscosity [5]

C Give the effect of copolymerization & crystallinity on rheology. [5]

SECTION II

Q. 7 A Derive an expression for velocity profile and shear rate at walls for flow of a Newtonian fluid through an annular cls. [6]

B Write a note on Hank's criteria used to study to study transition between laminar and turbulent flow for a Non-Newtonian fluid. [6]

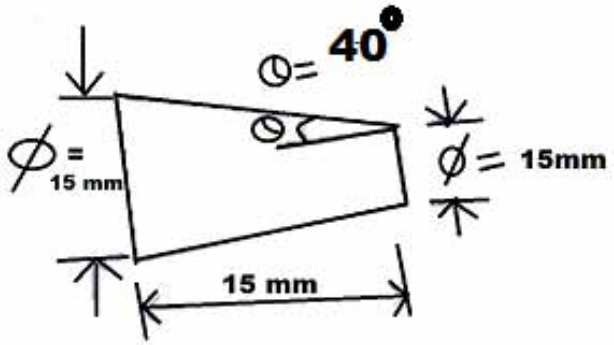
C A palmer melt flows through an annular cls of outside diameter 90 mm and inside diameter 86mm, length 150mm. The man flow rate is 72 kglhr and the melt follows power law $Z = 7000\ r^{0.3}$ .Melt-density is o.72 $glan^3$ find shear stren and presume drop. [6]

OR

Q. 8 A Explain uniaxial extensional flow encountered dusty polymer procuring with suitable examples [8]

B List the formulae for determining peruse drop due to shear and extension through a wedge shaped cls. Find pressure drop through a coni cylindrical section. As Sharon in fig 1. Melt obeys power low as $Z = 1,30,000\ r^{0.33}$ melt density = 0.76 $glam^3$ flow rate = 30 kglhr and [10]

tensile stren = 1.5 MPa.



Q. 9 A Write a rate on constructional features of a capillary rheomter. List the various corrections? [6]

B Determine the power law constants for the rheological data given below. Use analytical method [10]

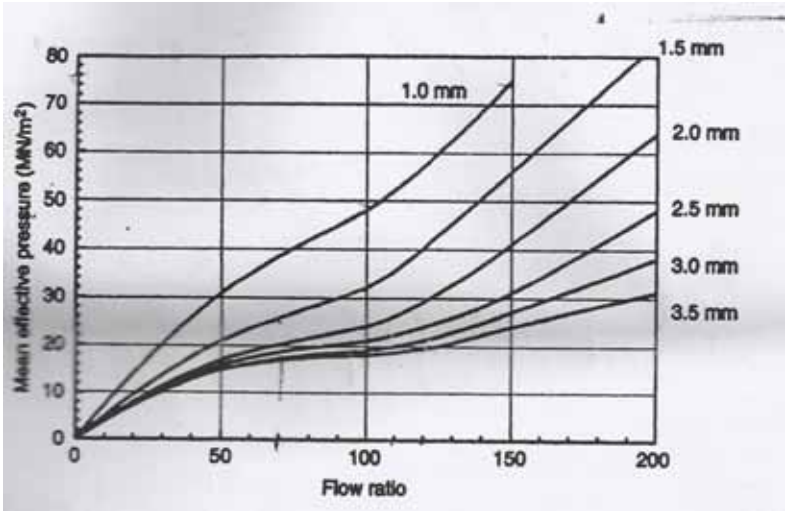
Shear rate (sec^{-1})	Shear stren (pa)
2.24	18,600
4.77	25,600
13.00	37,900
27.2	50,200
56.5	85,900
146.0	93,900,
296	121,000
594	154,000
1,450	202,000
2,850	247,000
5,770	320,000

OR

Q. 10 A Explain the importance of carrying out extensional rheological test for polymer melts. Describe any geometry used to study extensional flow behaviors [8]

B Derive an expression for apparent viscosityfor a a concentric cylinder rheometer when the inner cylinder is rotating in a bulls of fluid. [8]

Q. 11 A Two cavity mold is used to produce cups with a depth of 60mm having diameter 80 mm and thickens 2mm. Length of runner is 50mm and diameter 5 mm. Find the clamping force if the gate is located at bottom centre of the cup. Use graphs in figure 2 . cups are made of ABS with viscosity factor of 1.4. [8]



B Derive an expansion for flow length of a power law fluid when it is injected at a constant prename into a rectangular section channel, assuming isothermal flow. [8]

OR

Q. 12 A Compare pressure drop through a circular runner of radius 8 mm and length 60 mm with that through a semi circular runner of the same diameter and tength [8]

B Derive an expression for compaction force for a circular compression molded disc with radius R and thickens H [8]