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**T.E. (Polymer) (Sem. – II) Examination, 2009**  
**POLYMER RHEOLOGY AND PROCESSING**  
**(2003 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** books.  
3) **Neat** diagrams must be drawn **wherever** necessary.  
4) **Black** figures to the **right** indicate **full** marks..  
5) Your answers will be **valued** as a whole.  
6) **Use** of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.  
7) Assume suitable data, **if necessary**.  
8) **All** questions are **compulsory**.

SECTION – I

- |  |   |
|--|---|
| 1. a) Explain creep compliance.  | 2 |
| b) What are the three different types of forces that lead to deformation ? | 3 |
| c) Explain time dependent fluids with e.g.                                 | 3 |
| d) Explain the significance of isochronous stress strain plot.             | 4 |
| e) Explain with any 2 e.g.s. effect of normal stress.                      | 3 |
| f) What leads to melt fracture and how can one reduce it ?                 | 3 |

OR

- |   |   |
|---|---|
| 2. a) Explain the plot of creep and relaxation with respect to time for viscoelastic polymers.      | 4 |
| b) Explain tensile flow and how is it different from shear flow ?                                   | 3 |
| c) Why thermal conductivity and diffusivity are to be known in case of polymers during processing ? | 3 |
| d) Explain any one mechanical model to explain viscoelastic behaviour in polymers.                  | 8 |

P.T.O.



3. a) Why capillary rheometer is preferred to find viscosity over MFI ? **3**
- b) Explain effect of M.W. on melt rheology. **3**
- c) What is latent heat of fusion and in which polymers is it seen ? **3**
- d) Explain when one can observe superimposed shear flow on pressure flow with diagram and explain what happens to the shear rate. **7**
- OR
4. a) Explain the effect of shear rate on viscosity-M.W. relationship. **3**
- b) When polymer melt is made to flow thro' a die, what precaution needs to be taken ? **3**
- c) Viscosity of polymer melt is  $10^6$  Ns/m<sup>2</sup>. Time scale of the process is 20 seconds. If  $N_{DEB}$  is 10, find the modulus and explain the type of flow. **5**
- d) Polyethylene flows through an annulus having radius 10 mm,  $L = 30$  mm and  $H = 5$  mm. If  $\dot{\gamma}_{extrusion} = 3.5 \text{ sec}^{-1}$  and  $\dot{\gamma}_{total} = 34 \text{ sec}^{-1}$ , find  $\dot{\gamma}_{rotation}$  and volumetric flow rate. **5**
5. a) Write a short note on matrix notation and significance of all the co-ordinates it has. What happens when  $z_{ij} = z_{ji}$  ? **5**
- b) Explain continuity equation for compressible as well as incompressible flow. **8**
- c) Why rheology cannot be explained with the help of tensors ? Why vectors can only describe Rheology ? **3**
- OR
6. a) What is the importance of  $G'$ ,  $G''$  and  $\tan \delta$ ; and how can they be found ? **6**
- b) Show plot of  $r$  Vs time for elastic and viscous bodies when sinusoidal strain is applied. Also show the angle of lag for viscoelastic body. **5**
- c) Give two e.g.s. showing the use of vectors to explain deformation. **5**



SECTION – II

7. a) Explain the design features of grooved barrel and discuss applications, merits and demerits of the same. **6**
- b) Discuss general requirements of dispersive and distributive mixing sections used in extruder giving suitable e.g.s. **6**
- c) Explain the temperature distribution in the screw channel and discuss why inner portion remains comparatively hotter. **3**
- d) Discuss the flow in feed hopper and mention any two techniques of improving the flow. **3**

OR

8. a) Discuss contingencies melting model (CSM) and dispersed solid melting model (DSM) for melting in extruder. **6**
- b) Draw a neat sketch of development view of barrier section and explain the design features of barrier screw. Mention merits and demerits. **6**
- c) Draw neat sketches of any two cavity mixers and explain their functioning. **6**
9. a) In a extruder, screw having pitch equal to diameter, channel depth in metering is 2.4 mm, screw diameter is 60 mm and screw speed is 150 rev/min. Pressure varies linearly over screw length of 1000 mm from zero at entry to 20 mw/m<sup>2</sup> at the die entry. Estimate
- 1) drag flow                      2) pressure flow and
- 3) total flow ignoring leakage flow.
- Assume plastic viscosity as 200 N-sec/m<sup>2</sup>. Calculate also shear rate in the metering zone. **8**
- b) With a neat sketch explain extruder/die characteristics. **4**
- c) Explain, what is meant by autogenous extrusion speed ? **4**

OR



10. a) Derive an expression for drag flow for extruder screw assuming isothermal condition and for Newtonian fluid. **6**
- b) Explain, why depth of metering zone is usually kept shallow ? **2**
- c) Discuss the effect of channel depth and die characteristics on operating point. Discuss also the effect of temperature on extruder and die characteristics. **8**

11. a) A pp chair is manufactured on sequential as well as on parallel operation m/c with following cycle times.

Mold fast open	→ 1 sec
Mold slow open - I	→ 0.5 sec
Mold slow open - II	→ 0.5 sec
Mold fast close	→ 1.2 sec
Mold slow close	→ 0.5 sec
Mold safety time	→ 1.5 sec
Decompression	→ 2 sec
Cooling time	→ 20 sec
Tonnage time	→ 1.75 sec
Plasticizing time	→ 22 sec
Core - 1 out	→ 1 sec
Core - 1 in	→ 0.50 sec
Core - 2 out	→ 0.75 sec
Core - 2 in	→ 0.5 sec
Cycle delay	→ 1 sec
Fill time	→ 2.5 sec
Hold on time	→ 3 sec

Draw a cycle time bar chart for perfectly sequential m/c. Also draw a cycle time bar chart for parallel operation m/c, assuming core operations to be in parallel with plasticizing and mold opening.



- b) Write a short note on rubber molding and discuss any one molding technique. **4**
- c) Explain any one V-p switch over technique. **4**

OR

- 12.a) Draw a neat sketch of P-V-T diagram for amorphous or crystalline materials showing superimposition of injection molding cycle on it. Discuss as to how P-V-T diagram can be used for achieving consistency in molding. **8**
- b) Explain in short effect of too early and too late V-P switch over. **4**
- c) Explain how change in the hydraulic oil temperature, mold temperature and melt temperature affect injection molding process. **4**



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**T.E. (Polymer Engineering) (Sem. – II) Examination, 2009**  
**INSTRUMENTATION AND PROCESS CONTROL**  
**(2003 Course)**

Time : 3 Hours

Max. Marks : 100

- Instructions :** 1) Answers to the **two** Sections should be written in **separate** books.  
2) Draw **neat** diagrams **wherever** necessary.  
3) Numbers to the **right** indicate **full** marks.  
4) Assume suitable data, if **necessary**.  
5) Use of logarithmic table, electronic pocket calculators is **allowed**.

SECTION – I

1. a) A voltage 23.72 mv is generated with K type thermocouple with reference junction kept at 0° C. Find the temperature of measuring junction. **6**

Data : Thermocouple K type.

Voltage (mv)	Temperature °C
23.42	565
23.63	570
23.84	575
24.06	580

- b) A thermometer is calibrated from 25° C to 200° C. The accuracy of the thermometer is specified to be within i) within  $\pm 0.25\%$  of Span ii) within  $\pm 0.125\%$  of actual reading of 100° C. What is the maximum static error in both the cases ? **5**

P.T.O.



c) In radioactive level measuring instrument the accuracies of different elements are : **5**

Transmitter : within  $\pm 0.25\%$

Receiver : within  $\pm 0.125\%$

Indicator : within  $\pm 0.5\%$

Calculate the root square accuracy. Define the term root square accuracy.

OR

2. a) Discuss the followings with one example : **8**

Transducer, Signal Conditioner and Display element.

b) Explain the various Static and Dynamic Characteristics of measuring instruments. **8**

3. a) Write a note on : **10**

i) Strain gauge.

ii) Pneumatic transducer.

b) Explain with neat diagram, principle, construction, working of C-shaped Bourdon type pressure gauge. **6**

c) Define Pressure and Temperature terms with SI units. **2**

OR

4. a) Explain the use of Thermocouple Table. **4**

b) Discuss the desirable properties of Thermocouple. **5**

c) Write a note on reference junction temperature compensation used in thermocouple. **5**

d) Explain the Seebeck effect and Peltier effect. **4**

5. a) Explain with neat sketch the principle, construction, working of rotameter and derive the necessary performance equation applicable for the rotameter. **12**

b) Differentiate between differential Pressure flow meters Vs Variable area flow meters. **4**

OR



6. a) List out the various level measurement instruments. Describe any one in brief. **8**  
b) Define Bulk factor and explain the measurement of apparent density of polymers. **8**

SECTION – II

7. a) State any three benefits that can be achieved via process control system. **8**  
Explain the following terms with one example :  
Input Variable, Output Variable, Manipulated Variable, Disturbances.  
b) Define the term transfer function and derive applicable Transfer Equation for Mercury Filled Thermometer. **10**

OR

8. a) A thermometer with time constant 10 sec is placed in temperature bath and after it reaches steady state temperature of 30° C, it is suddenly placed into the water at 60° C. Find the response of the thermometer from steady state and find the output shown by the same at time = 10 sec. **8**  
b) Manometer 60 cm long, 6.3 mm ID glass tube half filled with water and subjected to differential pressure of 3500 N/m<sup>2</sup>. Find the applicable parameters and indicate whether the given manometer is suitable for given conditions, if not suggest the design solution for the same.  
Data :  $\mu = 10^{-3}$  kg m/sec, Density( $\rho$ ) = 1000 kg/m<sup>3</sup>. **10**

9. a) Discuss the followings : **8**  
i) Regular Control System  
ii) Servo Control System  
iii) Closed Loop Control System  
iv) Open Loop Control System.  
b) Derive the equation of overall transfer function applicable for feedback control system. **8**

OR





10. a) A second order system is observed to exhibit an under damped response giving Ultimate value = 16 and Minimum value = 10.  
Find the overshoot and maximum value for damping ratio ( $\xi$ ) = 0.6, 0.4, 0.2, 0.1.  
Discuss the effect of damping ratio on the overshoot. **8**
- b) Write a note on block diagram of simple feedback control system with suitable example and discuss the same with all standard symbols. **8**
11. Discuss in detail with one example any one Advanced Control Strategy. Discuss in detail any three modes of control action. **16**

OR

12. Write a note on the followings : **16**
- i) Sampling and Z transform.
  - ii) Computer Control System.
  - iii) Programmable Logic Control.
  - iv) Control Tuning.



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**T.E. (Polymer) (Sem. – II) Examination, 2009**  
**POLYMER MATERIALS – II (2003 Course)**

Time : 3 Hours

Max. Marks : 100

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

SECTION – I

1. a) Why only m-cresol is useful while o-8 p-cresols are not useful to synthesize PF resins ? 2
- b) Explain in brief “Additives in Novolak Moulding Powders”. 5
- c) Why saturated acids are used in synthesis of unsaturated polyester resins ? 2
- d) Write a short note on “Reactive Diluents” in unsaturated polyester resins. 3
- e) Enlist applications of unsaturated polyester resins. 3
- f) Why is it necessary to modify urea – formaldehyde resin to be used for surface coating applications ? 3

OR

2. a) Why cross-linking agents are essential for Novolaks while not necessary for Resols ? 3
- b) Give applications of Novolaks and Resols. 4
- c) For encapsulation of electronic components epoxy is preferred over unsaturated polyester. Why ? 3
- d) How is Epoxy resin characterized ? 6
- e) Compare properties of MF mouldings with UF mouldings. 2

P.T.O.



3. a) Write a short note on “Furan Resins”. 3
- b) Why polyether based flexible PU foams are preferred over polyester based flexible PU foams for cushioning applications ? 3
- c) What do you understand by “RIM” ? Explain in brief RIM process for polyurethanes. 3
- d) Write a short note on “Blowing Agents” in PU foams. 4
- e) What are Silicones ? Enlist the various forms/grades of Silicones. 3

OR

4. a) Write a short note on “Allyl Resins”. 3
- b) Why Rigid PU foam is preferred over Flexible PU foam in thermal insulation applications ? 4
- c) Give properties of Silicone Fluids. 3
- d) What are the applications of Room Temperature Vulcanizing (RTV) silicone elastomers ? 3
- e) Explain in brief “Bouncing Putty”, which is a Borosilicone product. 3
5. a) Explain the various terms used in the “Adhesive” field. 6
- b) Write a short note on “Pressure – Sensitive Adhesives”. 4
- c) Enlist various types of adhesives. 4
- d) Define the terms – Paint, Varnish. 2

OR

6. a) Write a short note on “Hot-melt Adhesives”. 4
- b) Explain the terms – Lacquer, primer, strain. 3
- c) What are “Convertible” and “Non-convertible” coatings ? 5
- d) Enlist the ingredients of paint formulation. 4



SECTION – II

7. a) Write a short note on “Latex Rubber Technology”. **6**
- b) To exhibit effective rubbery properties, which three primary structural requirements the material (polymer) should possess ? Explain in brief. **4**
- c) What is Mastication ? What are the advantages and limitations of mastication process ? **4**
- d) Although polymers like PE, polyacetals have simple side groups, they are rubbery in nature at room temperature. Why ? **2**

OR

8. a) Write a short note on “Raw Rubber Technology”. **6**
- b) What is the difference in Rubber and Elastomer ? **2**
- c) Although SBR contains bulky (phenyl) side group, it exhibits rubbery properties. Explain. **3**
- d) What characteristics/property make Rubber/Elastomer different from other polymeric materials ? **2**
- e) What causes reversible elasticity in rubbers ? **3**
9. a) What are the various additives used in rubber compound ? **5**
- b) Write a short note on carbon black filler used in rubbers. **3**
- c) Explain in brief Sulphur Vulcanization. **4**
- d) What are primary and secondary plasticizers ? **4**

OR

10. a) Explain the classification of fillers on the basis of reinforcement action they provide. **3**
- b) What are Facticees ? Give their advantages. **5**
- c) Explain in brief Non-Sulphur Vulcanization. **4**
- d) Why plasticizers are added in rubbers ? **4**



11. a) Comment on cold and hot polymerized SBR, and the difference between them. **6**
- b) Write repeating unit structures of the following (any 2) – NR, NBR, Polychloroprene. **4**
- c) What is the significance of third monomer in EPDM? Name the third monomer. **4**
- d) For SBR, carbon black addition is necessary. While for NR it is not. Why? **4**

OR

12. a) Write down various properties and applications of SBR. **6**
- b) What are the advantages of Thermoplastic Elastomers? **3**
- c) Write repeating unit structures of the following (any 2) – Polybutadiene, SBR, Buty rubber. **4**
- d) Comment on the effect of acrylonitrile content on the properties of NBR. **5**



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**T.E. (Polymer Engineering) (Semester – II) Examination, 2009**  
**POLYMER CHEMISTRY – II**  
**(2003 Course)**

Time : 3 Hours

Max. Marks : 100

- Instructions :** 1) *All questions are compulsory.*  
2) *Answer to the two Sections should be written in separate books.*  
3) *Figures to the right indicate full marks.*

SECTION – I

1. a) Explain the various steps involved in polymer dissolution. Also explain how polymer dissolution process is different from low molecular weight dissolution process. **9**  
b) Explain in detail types of degradation with suitable examples. **8**  
OR
2. a) Discuss thermal degradation process and various factors affecting the same. **9**  
b) Comment on solubility of crystalline and amorphous polymers. **8**
3. a) Explain the tacticity in 2-pentane. **9**  
b) Write a note on coordination polymerization mechanism. **8**  
OR
4. a) Compare and contrast Z-N and metallocene catalyst. **9**  
b) Write a note on properties of stereo regular polymers. **8**
5. a) Define copolymerization. What is its significance ? Explain various types of copolymers. **8**  
b) Derive copolymerization equation. Give the assumption involved in it. **8**  
OR
6. a) Give any three commercial applications of copolymers. **8**  
b) Write a note on applicability of copolymer equation. **8**

P.T.O.



SECTION – II

7. a) Give the synthesis and crosslinking reactions involved in  
i) Phenolic resins  
ii) Epoxy resins. 17  
OR
8. a) Give the synthesis and formulations for  
i) Unsaturated polyesters  
ii) Polyurethanes. 17
9. a) Write a short note on each of the following polymer reactions involving  
i) Acidolysis  
ii) hydrogenation  
iii) aldehyde  
iv) carboxyl. 17  
OR
10. a) Explain the following with suitable polymer reactions  
i) Vulcanization  
ii) Addition  
iii) Substitution  
iv) Aldehydes. 17
11. Derive kinetic expression for  
i) Anionic polymerization with termination  
ii) Cationic polymerization. 16  
OR
12. Derive kinetic expressions for 16  
i) Polycondensation  
ii) Free radical polymerization.
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**T.E. (Polymer) (Semester – I) Examination, 2009**  
**DESIGN OF EQUIPMENTS AND MACHINE ELEMENTS**  
**(2003 Course)**

Time : 3 Hours

Max. Marks : 100

**Instructions :** 1) Answers to the **two** Sections should be written in **separate** books.

2) **Neat** diagrams must be drawn **wherever** necessary.

3) **Black** figures to the **right** indicate **full** marks.

4) **Use** of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.

5) Assume **suitable** data, **if** necessary.

SECTION – I

1. a) Discuss at least three failure theories for a biaxial stress system. **12**  
b) Write a note on classification of tool steel according to Indian Standard. **4**

OR

2. a) A cylindrical steel shaft is subjected to a bending moment of 20 kN – m and torsional moment of 40 kN – m. Find diameter of the shaft using maximum strain energy theory if the yield strength of steel is 7000 MPa, modulus of steel  $E = 210$  GPa and Poisson's ratio is 0.25. Assume factor of safety = 2. **6**  
b) Draw Mohr's circle and show the principal stresses for the following stress condition  $\sigma_x = 100$  MPa;  $\sigma_y = 20$  MPa;  $\tau_{xy} = 60$  MPa. **10**
3. a) Design a muff coupling to transmit 30 kW at 144 rpm. The permissible shear and crushing strength for the shaft and key material are 30 MPa, and 80 MPa respectively. The sleeve is made of cast iron with shear strength of 15 MPa. Assume maximum torque to be 30% greater than nominal torque. **9**  
b) Derive an expression for driving tension ratio for flat belt drive. **9**

OR

P.T.O.





4. a) Design a cast iron protective type flange coupling to transmit 15 kW at 900 rpm from a electric motor to a compressor. The maximum torque is 1.35 times the nominal torque. The following permissible stresses may be used :

Shear stress in shaft, bolt and key = 40 MPa

Crushing stress for bolt and key = 80 MPa

Shear stress for cast iron = 8 MPa

Draw a neat sketch of the coupling.

12

- b) Design a clamp coupling to transmit 30 kW at 100 rpm. The allowable shear stress for shaft and key is 40 MPa. The number of bolts connecting the two halves are 6. Permissible tensile stress in the bolts is 70 MPa. The coefficient of friction between the muff and shaft surface is 0.3.

6

5. a) With a neat sketch, describe different types of sliding contact bearings.

6

- b) Define critical pressure and sommerfield number for journal bearings.

6

- c) State advantages and disadvantages of involute gears.

4

OR

6. a) Explain the complete design procedure for journal bearings.

4

- b) Write a note on footstep and collar bearings.

4

- c) Derive an expression for condition for constant velocity ratio of gears-law of gearing.

8

#### SECTION – II

7. a) With neat sketches, explain toggle, direct hydraulic and hydromechanical locking mechanisms and compare them with each other.

12

- b) Explain the use of accumulator as a energy causing device used in injection molding machine.

4

OR



8. a) With a hydraulic circuit, explain plasticising part of injection molding cycle. Explain also the application of back pressure. Explain clearly valve positions. **9**
- b) Explain the concept of high mold closing force (high mold safety) and low mold closing force (low mold safety) . **4**
- c) Explain the requirements of hydraulic oil for injection molding machine. **3**
9. With a neat circuit diagram, explain the following circuits :
- a) break circuit
- b) counter balance circuit
- c) regenerative circuit
- d) sequencing circuit with limited clamping pressure in one cylinder. **16**

OR

10. a) With a neat sketch, explain at least four different valve centre conditions for four way three position directional control valve. **6**
- b) Draw a neat sketch of pressure control valve and explain its function. **5**
- c) Draw a neat sketch and explain the function vane type pump. **5**
11. a) A cylindrical pressure vessel. 2 m in diameter is to operate at a pressure of  $4 \text{ kg/cm}^2$ . The permissible stress in the material is  $960 \text{ kg/m}^2$ . Welded joint efficiency is 85%. Calculate the thickness required for the vessel if this vessel is to be fabricated in the spherical form. What maximum pressure will it be able to withstand ? **6**
- b) Write short notes on (**any 3**) : **12**
- 1) Pressure vessel with half coil jacket construction
- 2) Nozzle reinforcement
- 3) Supports used in pressure vessel
- 4) Pressure vessel flange.

OR



12. a) A pressure vessel is to be designed for a certain process. The total volume of the vessel is  $7.5 \text{ m}^3$ , the vessel is to be operated at  $2.5 \text{ kg/cm}^2$ . The allowable stress in the material  $1060 \text{ kg/cm}^2$ . Welded joint efficiency is 85%. Corrosion allowance is 2 mm. Weight of the vessel with its contents is 6000 kg. The torque exerted over the vessel is 75 kg – cm. Bending moment exerted is negligible. The vessel is closed by two elliptical heads of major to minor axis ratio of 2.0. Estimate : (1) optimum proportions of the vessel (2) minimum thickness. **12**

b) A cylindrical pressure vessel 1.8 m in diameter and 5 m in height is subjected to an internal pressure of  $8 \text{ kg/cm}^2$ . Corrosion allowance is 2 mm. If the vessel is fabricated as i) Class 'B' vessel with  $J = 0.85$  2) Class 'C' vessel with  $J = 0.5$  and  $0.7$ . If a strip of suitable size is welded along the longitudinal joint ( $J = 0.1$ ), what will be the thickness of the vessel ? What will be the percentage saving in the material ? **6**

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**T.E. (Polymer Engineering) (Sem. – I) Examination, 2009**  
**CHEMICAL ENGINEERING OPERATIONS**  
**(2003 Course)**

Time : 3 Hours

Max. Marks : 100

- Instructions :** 1) Answers to the **two** Sections should be written in **separate** books.  
2) Draw neat diagrams **wherever** necessary.  
3) Numbers to the **right** indicate **full** marks.  
4) **Assume** suitable data, if **necessary**.  
5) **Use** of logarithmic table, **electronic** pocket calculators is **allowed**.

SECTION – I

1. a) Derive an expression for the Steady State Diffusion of A through non diffusing B and discuss the same case with one application. **10**
- b) Discuss in detail the term Molecular Diffusion along with its importance. **6**

OR

2. a) Write a note on : **8**
- i) Mass Transfer Coefficient
- ii) Eddy Diffusion
- b) Explain the Fick's Law for the diffusion through solid and explain the phenomena of diffusion through polymers and porous solid. **8**
3. a) Discuss the working of the Packed Tower with neat diagram. **6**
- b) Explain the term operating line and derive the expression for the slope of the operating line in co-current and counter- current operations. **10**

OR

P.T.O.



4. a) Explain the following terms : **10**  
Simple distillation, Azeotropic Distillation, Reflux ratio, Extraction, Enriching Section.
- b) Write a note on Operating Characteristics of Tray Tower. **6**
5. a) Discuss the terms Humidification and Dehumidification. **4**
- b) Explain the drying phenomenon associated with batch tray dryers. **6**
- c) Discuss the Direct Contact Dryers and Freeze Drying. **8**

OR

6. a) Wet sand is dried from 35% to 10% moisture under drying condition in 18523 seconds. For the same set up equilibrium moisture content is 2% and critical moisture content is 15%. How much moisture content will be there at the end of 20000 seconds ? **6**
- b) Discuss the followings : Ultra filtration, Electro dialysis. **8**
- c) Discuss the following terms : **4**  
i) Absolute Humidity      ii) Humid heat.

SECTION – II

7. a) Write a note on Rate of mixing. **6**
- b) Discuss the importance of mixing Index and Derive the necessary equation for mixing Index applicable for Cohesive solids. **10**

OR

8. a) Discuss in detail the Scale of Admixture. **8**
- b) Write a note on Mixing Mechanism. **8**



9. a) Discuss with neat diagram in detail the Mixing mechanism, construction, methods of improving cross-mixing action and applications of two-roll mill. **12**
- b) Discuss in detail Eccentric rotating drum tumble blenders. **6**

OR

10. a) Discuss with neat diagram the construction and mixing action of Ribbon Blender and Muller Mixer. **10**
- b) Write a note on Sigma Mixer. **8**
11. a) Write a note on Dry Blending of PVC. **8**
- b) Discuss in detail all the necessary compounding cycle steps for Thermoplastics by using suitable graph of Power consumption Vs Time. Discuss the optimum operating conditions for the same. **8**

OR

12. a) Discuss in detail any one application based formulation of Polyvinyl Chloride. **8**
- b) Discuss the Importance of Plasticizer and filler in PVC Compounding. **8**

**T.E. (Polymer) (Semester – I) Examination, 2009**  
**Branch : POLYMER MATERIALS – I**  
**(2003 Course)**

Time : 3 Hours

Max. Marks : 100

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

SECTION – I

1. a) What is the significance of K-value in PVC ? Explain in brief the method to find out K-value. (5)
- b) Write down the names of various monomers used in ABS, SAN. (3)
- c) State 2 properties and 2 applications of ABS. (4)
- d) PP can be used in medical applications. True or False. Justify the answer. (2)
- e) State 2 applications and 2 properties of PMMA. (4)

OR

2. a) What are the different additives used in PVC formulation before processing ? (5)
- b) Expandable polystyrene floats in water. True or False. Justify the answer. (3)
- c) What are the various grades of PP due to tacticity ? What is the effect of tacticity on the properties of PP ? (5)
- d) Why mechanical properties of LLDPE are superior to LDPE ? (4)
- e) Draw structure of repeating unit of PMMA. (1)

P.T.O.



3. a) What is degree of acetylation of cellulose acetate ? How does it affect properties of cellulose acetate ? (5)
- b) Write a short note on “Ethyl cellulose”. (5)
- c) Give 2 applications of polyvinyl acetate and polyvinyl alcohol. (4)
- d) What is the chemical structural difference in polyvinyl acetate and polyvinyl alcohol ? (2)

OR

4. a) Can cellulose be processed by following techniques :
- i) melt
  - ii) solution
  - iii) both melt and solution
  - iv) none of the above.
- Justify your answer. (3)
- b) State various modified forms of cellulose. Draw the structure of repeating unit of at least two forms/compounds. (5)
- c) Is cellulose a Natural or Synthetic polymer ? Draw repeating unit structure of cellulose. (2)
- d) What are the different grades of polyvinyl alcohol ? How do they differ ? Give at least two applications of each grade. (6)
5. a) Explain the role of following additives. Give at least one example of each additive.
- i) Plasticizers
  - ii) Lubricants
  - iii) Extenders
  - iv) Fillers
  - v) Antioxidants. (10)
- b) Write a short note on “Antiozonants”. (3)
- c) Why plasticizers are necessary in PVC formulations ? (3)

OR





6. a) What are the essential features a compound/material should possess to be used as an additive ? (6)
- b) What are internal and external lubricants ? Give two examples of each. (5)
- c) Write a short note on “Classification of Fillers”. (5)

SECTION – II

7. a) What are the advantages and limitations of polycarbonate ? (5)
- b) Between Nylon 6, 6 and Nylon 6, 10 which is more hygroscopic ? Why ? (3)
- c) What does the numbers in various Nylons (for eg. 6, 6 in Nylon 6, 6) signify ? (2)
- d) Aromatic polyamides (Aramids) have more strength compared to conventional polyamides (Nylons). True or False. Justify the answer. (3)
- e) Write a short note on “Mechanical Properties of Polyacetals”. (5)

OR

8. a) What are the applications of polycarbonate ? (5)
- b) Comment on the effect of number of carbon atoms present in chain on the properties of Nylons. (5)
- c) Write a short note on “Applications of Aromatic polyamides (Aramids). (3)
- d) Polyacetals are normally processed at the temperature less than 270°C. Why ? (5)
9. a) Write down the applications of PET and PBT. (6)
- b) Why PTFE is chemically inert ? (3)
- c) What is the monomer of PTFE ? Draw the repeating unit structure of PTFE. (2)
- d) Comment on properties of Polyetherimide. (5)

OR



10. a) PET and PBT are saturated polyesters. True or False. Justify the answer. (3)
- b) Enlist the monomers present in PET and PBT. (3)
- c) Give the properties of PTFE. (5)
- d) Give 3 applications of polyetherimide. (3)
- e) Which is the monomer present in polyetherimide ? Draw the repeating unit structure of polyetherimide. (2)
11. a) Write down applications and properties of PPO. (5)
- b) What is PPS ? Give applications of PPS. (5)
- c) Draw repeating unit structure of PEEK. Give 3 properties of PEEK. (6)

OR

12. a) What is PPO ? Compare the properties of PPO with PPS. (6)
- b) Write down short note on “PEEK”. (5)
- c) Write down applications of PPS. (5)
-



**T.E. (Polymer Engg.) (Semester – I) Examination, 2009  
MATHEMATICAL METHODS IN POLYMER ENGG.  
(2003 Course)**

Time : 3 Hours

Max. Marks :100

- N.B. :** 1) In Sect. I attempt Qu. 1 or Qu. 2, Qu. 3 or Qu. 4, Qu. 5 or Qu. 6  
In Sect. II attempt Qu. 7 or Qu. 8 Qu. 9 or Q. 10, Qu. 11 or Qu. 12.  
2) Answers to the **two** Sections should be written in **separate** books.  
3) **Neat** diagrams must be drawn **wherever necessary**.  
4) **Black figures** to the **right** indicate **full marks**.  
5) **Use of electronic pocket calculator is allowed**.  
6) Assume suitable data, if necessary.

SECTION – I

1. a) Establish the following :

i)  $\left( E^{1/2} + E^{-1/2} \right) (1 + \Delta)^{1/2} = 2 + \Delta$

ii)  $\frac{1}{\nabla} y_n - \frac{1}{\Delta} y_0 = y_0 + y_1 + y_2 + \dots y_n$

iii)  $E = \left( \frac{\delta}{2} + \sqrt{1 + \frac{\delta^2}{4}} \right)^2$

9

b) For the tabulated data

x	0	1	2	3	4	5
y	1.12	3.45	6.67	10.8	16.12	24.52

8

find y at x = 0.5,  $\frac{dy}{dx}$  at x = 5.5

OR

2. a) Find the real root of the equation  $x^3 + 2x - 5 = 0$  by applying Newton-Raphson method, at the end of fifth iteration write the algorithm for above method.

9

b) Find Lagrange's interpolating polynomial passing through set of points

x	0	2	3	4
y	4	6	7	9

and evaluate  $\int_0^3 y dx$ .

8

P.T.O.



3. a) Solve the following system of equations by the Gauss-Seidel method

$$10x_1 + x_2 + x_3 = 12$$

$$2x_1 + 10x_2 + x_3 = 13$$

$$2x_1 + 2x_2 + 10x_3 = 14$$

8

b) Solve the equation.

$$\frac{dy}{dx} = 1 + xy \quad [x_0 = 0, y_0 = 1]$$

to find  $y$  at  $x = 0.1$  and  $x = 0.2$  using modified Euler's method, taking  $h = 0.1$ .

9

OR

4. a) Use Runge-Kutta method of fourth order to solve the equation

$$\frac{dy}{dx} = \sqrt{x+y} \quad [x = 0, y = 1]$$

to calculate  $y$  at  $x = 0.4$  taking  $h = 0.2$ .

9

b) Write the algorithm for the following :

i) Euler's method for solving differential equation of first order

ii) Simpson's  $\frac{1}{3}$ rd rule for Numerical integration.

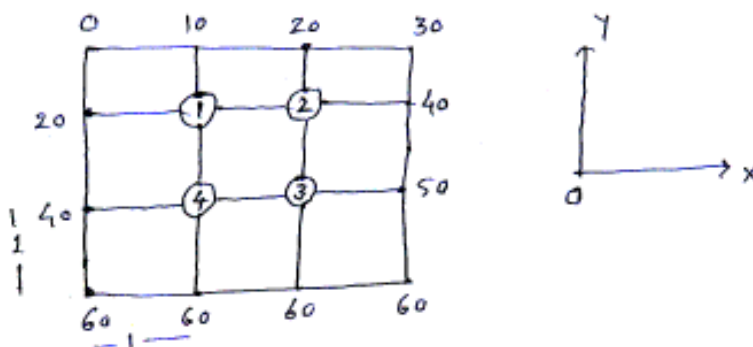
8

5. a) Solve the equation :

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$$

with reference to the grid shown in the following figure.

8



b) Fit the straight line of the form  $y = mx + c$  to the following data, using method of least squares.

x	0	1	2	3	4	5	6
y	-3	-1	1	3	5	7	9

8

OR



6. a) Use explicit finite difference method to solve the equation  $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$  subject to the conditions

i)  $u(0, t) = 0$       ii)  $u(1, t) = 0$

$$u(x, 0) = 2x \quad 0 \leq x \leq \frac{1}{2}$$

$$= 2(1 - x) \quad \frac{1}{2} \leq x \leq 1$$

taking  $\delta x = 0.1$ ,  $\delta t = 0.001$ , find  $u(x, t)$  at  $t = 0.001, 0.002, 0.003$ .

8

b) Use Trapezoidal rule to numerically evaluate

$$I = \int_0^1 x.e^{x^2} dx \text{ by taking } h = 0.1$$

compare the approximate value with exact value.

8

SECTION – II

7. a) Fluctuations in the Aggregate of marks obtained by two groups of students are given below. Find out which of the two shows greater variability.

9

<b>Group A</b>	518	519	530	530	544	542	518	550	527	527	531	550	550	529	528
<b>Group B</b>	825	830	830	819	814	814	844	842	842	826	832	835	835	840	840

b) The first four moments about the working mean 30.2 of the distribution are 0.255, 6.222, 30.211 and 400.25. Calculate the moments about the mean. Also evaluate coefficients of skewness and kurtosis.

8

OR

8. a) A, B play the game of alternate tossing the coin. One who gets Head first wins the game. Find the probability of B winning the game if A has a start.

5

b) Find the number of ways in which letters in the word “MALYALAM” be arranged, so that the two M’s are always together.

5

c) Obtain regression line of y on x for the following data.

7

<b>x</b>	6	2	10	4	8
<b>y</b>	9	11	5	8	7



- 9. a) A manufacturer of cotter pins knows that 2% of his product is defective. If he sells cotter pins in boxes of 100 pins and guarantees that not more than 5 pins will be defective in a box, find the approximate probability that a box will fail to meet the guaranteed quality. 6
- b) The Mean and Variance of Binomial distribution are 6 and 2 respectively. Find  $p$  ( $r \geq 3$ ). 6
- c) In a Poisson distribution if  $p(r = 1) = 2 p(r = 2)$ , find  $p(r = 3)$ . 5

OR

10. a) In experiment on pea breeding, the following frequencies of seeds were obtained :

Round and green	Wrinkled and green	Round and yellow	Wrinkled and yellow	Total
222	120	32	150	524

Theory predicts that the frequencies should be in proportion 8:2:2:1. Examine the correspondence between theory and experiment. [ $\chi^2_{3,0.05} = 7.815$ ]. 6

- b) Find the unique fixed probability vector  $\bar{t}$  of the matrix  $A = \begin{bmatrix} 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/4 & 1/4 \end{bmatrix}$ .

Which matrix does A approach as n becomes larger ? 6

- c) In a certain examination test, 2000 students appeared in a subject of statistics. Average marks obtained were 50% with standard deviation 5%. How many students do you expect to obtain more than 60% of marks, supposing that marks are distributed normally ? 5  
 [ $z = 2, A = 0.4772$ ]

11. a) If  $A_r^{pq}$  is a tensor, show that  $A_r^{Pr}$  is a contravariant tensor of rank one. 5

- b) Prove that a)  $[pq, r] = [qp, r]$ , b)  $\begin{Bmatrix} s \\ pq \end{Bmatrix} = \begin{Bmatrix} s \\ qp \end{Bmatrix}$ . 5

- c) A covariant tensor has components  $xy, y^2z, xz^2$  in rectangular coordinates. Find its covariant components in cylindrical coordinates. 6

OR

12. a) Determine the metric tensor in a) cylindrical and b) spherical coordinates. 5

- b) Determine whether each of the following quantities is a tensor. If so, state whether it is contravariant or covariant and give its rank : 5

a)  $dx^k$     b)  $\frac{\partial \phi}{\partial x^k}$ .

- c) A covariant tensor has components  $2x-z, x^2y, yz$  in rectangular coordinates. Find its covariant components in spherical polar coordinates. 6