

Ex/M. MTRL/9866/192/2004

M. TECH. IN MATERIAL ENGINEERING EXAMINATION, 2004

(1st Semester)

POLYMERIC MATERIALS

Time : Three hours

Full Marks : 100

(50 marks for each part)

Use a separate answer-script for each part.

PART—I

Answer questions no. 1 and *two* others from the rest.

1. (i) Write down the Mer structure of PTFE and PS. Using Structure-Property relationship comment on Processability and Transparency of the respective mers.

(ii) What is a co-polymer. Give example.

(iii) Oxygen permeability of the following polymers are given :

<u>Material</u>	<u>Oxygen Permeability</u>
Natural Rubber	4.0
PS	0.5
PA	0.006

Explain the reason for variation in permeability values.

(iv) What are the differences between thermoplastic and thermosetting polymers ?

[Turn over

(2)

(v) Write down Mer Formula for Isoprene Rubber. Twenty gms of sulfur is added to 100 gm of Isoprene. What is the maximum fraction of cross link sites that can be connected ? $4+3+3+4+6 = 20$

2. (i) What is meant by Isochronous Graph ?

(ii) From the creep curves given in the figure 1, draw the one year Isochronous graph of polypropylene.

(iii) A polypropylene beam is 100 mm long, simply supported at each end and is subjected to a load W at its mid span. If the maximum permissible strain in the material is to be 1.5%, calculate the largest load which may be applied so that the deflection of the beam does not exceed 5 mm in a service life of 1 yr. For the beam $I = 28 \text{ mm}^4$ and the creep curves in Fig. 1 should be used. $2+3+10 = 15$

Xerox copy of Figure 1—attached.

3. (i) Deduce the creep and Relaxation behaviour in response to a Maxwell Model.

(ii) The viscoelastic behaviour of a certain plastic is to be represented by spring and dashpot elements having constants of 2 GN/m^2 and 20 GNS/m^2 respectively. If a stress of 12 MN/m^2 is applied for 100 secs and then completely removed. Compare the values of strain predicted by Maxwell and Kelvin Voigh Models after (a) 50 secs (b) 150 secs. $7 + 8 = 15$

4. (i) From the following data, determine which process will need robust machine and which will need light machine.

(3)

	<u>Shear Rate (S^{-1})</u>	<u>Material Viscosity (Pas)</u>
Injection Moulding	$10^3 - 10^5$	150
Rubber Calendering	10	5×10^2
Plastiol Spreading	100	3×10^{-1}

(ii) Show typical zones on an extruder screw and explain the functions of each zone.

(iii) Name two applications of Blow Molding.

(iv) A blow moulding die has an outside diameter of 30 mm and an inside diameter of 27 mm. The parison is inflated with a pressure of 0.4 MN/m^2 to produce a plastic bottle of diameter 50 mm. If the extrusion rate used causes a thickness swelling ratio of 2, estimate the wall thickness of the bottle. Comment on the suitability of the production conditions if melt fracture occurs at a stress of 6 MN/m^2 . $3 + 5 + 1 + 6 = 15$

PART—II

Answer any *three* questions.

All questions carry equal marks.

2 marks allotted for concise and to the point answer.

6. What is copolymerization ? How many varieties of copolymers are there ? How will you find out glass transition temperature (T_g) of a copolymer? What do you mean by T_g of a homopolymer ?

[Turn over

(4)

7. What do you mean by creep and stress-relaxation of a polymer? What informations do you get? What will be the type of responses of an ideally elastic, viscous and viscoelastic plastic material to an instantaneous stress at initial time? What type of impact tests are carried out for plastic materials and what informations do you get ?

8. What do you mean by number-average and weight-average molecular weight of a polymer? How are they expressed? What do you mean by polydispersity index of a polymer and how is it obtained? How molecular weight of a polymer affect its properties ?

9. What are the basic three properties upon which the end properties of a polymer depend? What types of molecular weight distributions are obtained in case of polymeric materials and how do they affect the properties? What is the difference between LDPE, HDPE and MDPE with regard to structure of the end product polyethylene ?

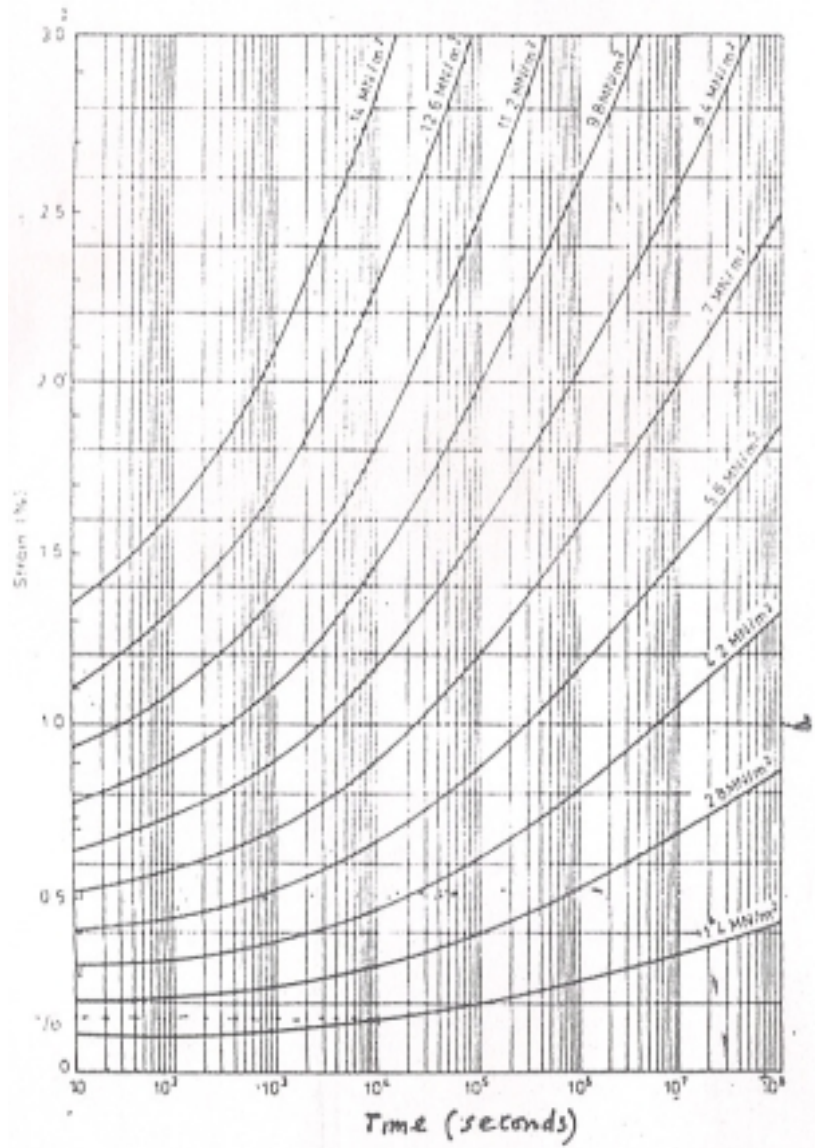


Fig 1. Creep curves for polypropylene at 20°C (density 909 kg/m³)