INDIAN RUBBER INSTITUTE
PGDIRI EXAMINATION – 2023

Paper – IV

Date : 10th March, 2024 **Time : 14.00 – 17.00 hrs.**
Duration : 3 Hours **Full Marks : 100**

RUBBER PRODUCT MANUFACTURING AND THEIR EVALUATION

Answers should be illustrated with sketches wherever helpful
Total **FIVE** questions are to be answered. **Question number 1** is compulsory. Answer **four** from the remaining questions taking **two** from each group

GROUP – A

1. Select the correct answers from the given alternatives: **(1 x 20) = 20**

(i) Rubber Hardness has got close correlation with:
(a) Tear strength (b) Modulus (c) Tensile strength (d) Elongation at break

(ii) Width/height ratio in conventional wedge type V-belt is
(a) 1.6/1.0 (b) 2.6/1.6 (c) 1.6/1.2 (d) 1.2/2.1

(iii) The neutral angle associates with braided hose design is .....
(a) 55°44' (b) 44°54' (c) 54°44' (d) 44°55'

(iv) Foxing is one of the components of:
(a) Tyre (b) Rain coat (c) Rubber canvass foot wear (d) Transmission belt

(v) Tangent delta is the ratio of .....
(a) Storage modulus/Loss modulus (b) Loss modulus/ Storage modulus
(c) Complex modulus/ Loss modulus (d) Loss modulus/Complex modulus

(vi) 'Peel' test is associated with
(a) Bond testing of fabric to rubber (b) Moulded rubber (c) Hose (c) Fabric abrasion

(vii) Plunger test is relevant to .....
(a) Tyre (b) V-Belt (c) Hose (d) Conveyor belt

(viii) The term "last" is related to
(a) Latex dipped products (b) Injection moulded products
(c) Hot water bottle (d) Footwear

(ix) Drum friction test is relevant to
(a) Conveyor belt (b) V-belt (d) Tyre (c) Hose

(x) The tern "Run-Flat" is associated with:
(a) Conveyor Belts (b) V-belt (c) Tyre (d) Hose

(xi) If a solid rubber ball is freely falling from a height "X", bounce back to a height "Y", then the resilience of the ball can be estimated from,
(a) (1- cos X)/(1-cos Y) (b) 1+X/1-Y (c)Y/X (d) X/Y

(xii) The term "compression ratio" is relevant to :
(a) Compression moulding (b) 2-roll mixing mill (c) 3-roll calender (d) Extruder

(xiii) In a braided hose, if the braid angle is greater than the neutral angle, the hose will;
(a) Have no change during service (b) Decrease in diameter
(c) Decrease in length (d) Elongate in the direction 45^0 to the hoop force

(xiv) Corona resistance test is related to
(a) Hose (b) Tyre (c) Cable (d) V-belt

(xv) The highest voltage up to which paper insulated cable can be used
(a) 12 kV (b) 33 kV (c) 6 kV (d) 66 kV (e) 166 kV

(xvi) Skid resistance is a term related to
(a) V-belt (b) Conveyor belt (c) Tyre (d) Hose

(xvii) Angle of steel cords in the belt of a radial tyre
(a) 12^0 - 18^0 (b) 35^0 - 40^0 (d) 85^0 - 90^0 (c) 25^0 - 30^0

(xviii) Magnetron is the source of energy for :
(a) Fluidized bed curing (b) Microwave curing (c) Roto curing (d) Electron beam curing

(xix) Property associated with change of strain with time when subjected under constant stress is
(a) Set (b) Creep (c) Fatigue (d) Stress relaxation

(xx) Life testing is the most important test for
(a) Tyre (b) V-belt (c) Hose (d) Cable

6+6+4+4) = 20

2. (a) Draw a section diagram of a Bias ply tyre indicating its various components.
(b) Explain with diagram the different types of constructional pattern of Bias tyre, Bias-Belted tyre and radial tyre.
(c) What is PCI and why it is necessary in tyre manufacturing?
(d) What are the important properties required for passenger car tyre tread compound?

5 x 4 = 20

3. (a) Sketch the different components of a cable.
(b) Write a typical formula for high quality heat resistant cable cover compound. Explain the reasons for the choice of ingredient?
(c) Define dielectric constant & loss factor and name some instruments where these two parameters can be measured?
(d) Formulate a typical flame resistance jacket compound for cable and justify your formulation?

(6+6+4+4) = 20

4. (a) Discuss different functional requirements of conveyor belt?
(b) In conveyor belt terminology, what do you mean by M-24, N-17, EP and PP?
(c) Discuss on Drum friction test for Conveyor belt?
(d) Discuss the selection of base rubber/blends for conveyor belt compound with special reference to the following applications and justify your answer
i) Flame and fire resistant, ii) Conveyor belt for coal mine iii) Super heat resistance.

GROUP – B

10 + (5x2) = 20

5. a) Calculate tensile strength, modulus at 100%, 200% & 300%, elongation and elongation at break for the given tensile test piece. The change in bench mark with applied load is given below, (sample thickness = 2 mm, width = 5mm, length = 40 mm)

Load (Kg)	0	2.0	3.5	5.5	7.5	10.5	14.0	18.0	20.0	25	25.001
Bench Mark (mm)	20	25	30	40	55	72	80	100	130	140	Failure

Addition
8:5
60

b) Write appropriate unit for the following terms:
   i) Tensile strength and tear strength
   ii) Modulus @ 300% elongation and elongation at break
   iii) Resilience and heat build up
   iv) Volumetric and gravimetric abrasion loss
   v) Flex resistance and electrical resistance

(5+5+4+6) = 20

6. (a) What is meant by " Standards and Specification"?.
   (b) Write down briefly the basic aspects about quality assurance activity in a manufacturing unit.
   (c) What is the purpose of using a Mooney viscometer and Rheometer?
   (d) Draw a standard curve for Mooney viscometer and a Rheometer & explain.

(4+7+5+4) = 20

7. (a) What necessary action will you take to prepare metal surface prior to bonding with rubber?
   (b) Describe briefly the manufacturing steps of any one metal to rubber bonded product.
   (c) What are the different methods of measurement of metal-rubber bond strength?
   (d) Formulate a metal bonded rubber seal. What type of bonding agent will you recommend for this product?

(5 x 4) = 20

8. Write short notes on (**any four**)
   (a) Rolling resistance
   (b) Tubeless tyres
   (c) Manufacturing of rubber rolls
   (d) High voltage cable insulating materials and properties
   (e) Tensile and Tear test for rubber vulcanizate
   (f) Structure of carbon black