INDIAN RUBBER INSTITUTE

PGD-IRI EXAMINATION – 2016

Paper - III

Date: 23.07.2016 **Time: 10.00-13.00 hrs.**

Duration: 3 Hours **Full Marks : 100**

RUBBER MATERIALS

Answers should be illustrated with sketches wherever helpful

Total **FIVE** questions are to be answered. From **Question No. 1** is compulsory. Answer **FOUR** from the remaining questions taking TWO from each group.

GROUP – A

1. Choose the correct answer from the given alternatives :

(i) What is T_g of High Cis-BR

(a) –100°C (b) –40°C (c) –55°C (d) –70°C

(ii) NOBS acts as a

(a) Plasticizer (b) Peptizer (c) Retarder (d) Accelerator

(iii) Which of the following types of carbon black possesses the highest surface area ?

(a) SAF (b) SRF (c) HAF (d) FEF

(iv) Flame resistance property is found to be the best with

(a) NR (b) EPDM (c) CIIR (d) CR

(v) Which property of SBR will be improved when blended with NR

(a) Oil resistance (b) Heat resistance

(c) Tear strength & tensile strength (d) Abrasion resistance

(vi) The highest gas impermeability at room temperature is shown by the polymer:

(a) NBR (33% ACN) (b) IIR (c) NBR (50% ACN) (d) BR

(vii) Select the best rubber can be used for acid resistant tank lining

(a) NR (b) Hypalon (c) NBR (d) EPDM

(viii) For tyre curing bag the most suitable rubber is

(a) NBR (b) CR (c) IIR (d) SBR

(ix) The most delayed action accelerator is

(a) MBT (b) CBS (c) TMTD (d) MOZ

(x) Which of these dienes is present in EPDM

(a) Dicyclopentadiene (b) Cyclohexadiene

(c) Chlorobutadiene (d) Hexamethylenetetramine

(xi) The accelerator which gives the best delaying action is

(a) Guanidine (b) Thiazole

(c) Sulphenamide (d) Dithiocarbamate

(xii) Bonding of steel cords to rubber compounds is achieved by the addition of

(a) Cobalt salts (b) Zinc salts

(c) Copper compounds (d) Fatty acids

(xiii) Which of these thermoplastic elastomers has the best oil resistance

(a) TPO (b) TPU (c) SEBS (d) SBS

(xiv) Blooming in rubber compounds can be prevented by use of

(a) Colloidal sulfur (b) Insoluble sulfur

(c) Oil-coated sulfur (d) Soluble sulfur

(xv) 100% hydrogenated NBR can be vulcanized by

(a) Sulphur and accelerators (b) Peroxides

(c) Metal oxides (d) None of the above

(xvi) Which filler has the highest specific gravity

(a) Ppt $CaCO_3$ (b) Silica (c) Barytes (d) China clay

(xvii) Select a cure system for best flex life of cured product

(a) Semi EV (b) EV (c) Peroxide (d) Conventional

(xviii) High dosage of ZDC is used as an accelerator in

(a) Tyre (b) Latex product (c) Conveyor belt (d) Hose

(xix) Wood resin is mainly used a

(a) Plastieizer (b) Flame retardant (c) Tackifier (d) Curative

(xx) Chemical used as coagulating agent for NR latex is

(a) Ammonia (b) Sulfuric acid (c) Acetic acid (d) Calcium carbonate

(1 x 20) = 20

2. a) Design three Natural rubber gum compounds for curing by conventional, semi-efficient and efficient vulcanization systems with keeping in mind equivalent state of cure, and account for the ingredient you have used.

b) Compare the following properties with respect to above three curing systems with proper reasoning,

(i) Set property

(ii) Age resistance and flex crack resistance

c) (i) Write down the composition of natural rubber latex ?

(ii) Why it is necessary to concentrate natural rubber latex ?

(iii) Explain what is protein allergy ?

(3x2+4+3+3+4)=20

3. a) How following characteristics of a filler when added will affect processing behavior andvulcanized properties of a rubber compound.

(i) Particle size

(ii) pH

(iii) Surface area

(iv) Structure

b) Name a few non-black filler and arrange them in order of their reinforcing ability.

c) What is coupling agent? When and why it is used?

d) You are asked to formulate tread components for cycle tyre and truck tyre. What are themajor differences in compound formulation with respect to different ingredient used in two formulations ?

(8+ 3+ 4 + 5) = 20

4. a) Calculate the ash content (%) of following formulations :

SBR	100
ZnO	5.0
Stearic acid	2.0
Magnesium carbonate	30
Calcium carbonate	40
Silica	20
HAF	30
Aromatic oil	10
TMTD	0.5
MBTS	1.2
Sulphur	2.0

b) (i) Name the classes of the accelerators which belong to the following categories and give a few examples of each type.

(a) ultra –accelerators

(b) semi-ultra accelerators

(c) normal or medium activity accelerators

(d) low activity accelerators

(ii) What do you mean by N-110, N-242, N-326, N-660? What these numbers stand for ?

(6 + 8 + 6) = 20

[Turn Over]

Group – B

5. a) State what is meant by the following applied to textiles.
   (i) Denier (ii) Tex (iii) Yarn count (iv) Thermal shrinkage
   b) What is the advantage of aramid over steel ?
   c) Why polyester is preferred over nylon in V-belt ?
   d) Name three products where nylon 6 is used.
   e) Why post cure inflation (PCI) in nylon reinforced truck tyre is recommended? Mention the procedure of PCI.

(8 + 2 + 2 + 3 + 5) = 20

6. a) What are Thermoplastic Elastomers and how are they different from thermoset elastomers
   b) Mention different types of thermoplastic elastomers available and their main applications.
   c) What is the difference between TPOs and TPVs ?

(6 + 10 + 4) =20

7. a) Mention the most suitable elastomer(s) for each of the following, and give reasons why.
   i) Tyre curing bag for automobile tyre.
   ii) High voltage cable insulation.
   iii) Liquified petroleum gas tubing.
   iv) Inner tube for oil field hose.
   v) Flame retardant cover compound for conveyor belt.

   b) Write down a typical recipe for any one of the above items, justifying your choice in ingredients.
   c) Select suitable curing systems for EPDM and IIR.

(2 x 5 + 6 + 4) = 20

8. Write short notes on any four of the following :–
   a) Plasticizers for NBR & IIR
   b) Retarders
   c) Semi-EV system
   d) Microstructure and properties of solution and emulsion SBR
   e) Extenders
   f) Peptizer
   g) Curing agent for FKM & Hypalon

(4 x 5) = 20