INDIAN RUBBER INSTITUTE
DIRI EXAMINATION – 2014

Paper – III

Date: 12 July, 2014 **Time: 10.00 – 13.00 hrs.**
Duration: 3 Hours **Full Marks: 100**

Rubber Materials, Rubber Compounding and Reinforcement

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

GROUP – A

1. Multiple choice questions: Select the correct answer from the given alternatives:

(i) Which polymer swells the least when immersed in petrol?
(a) IIR (b) EPDM (c) SBR (d) CSM

(ii) Which of the following rubbers possesses highest self protection against ozone?
(a) EPM (b) NBR (c) SBR (d) EPDM

(iii) Which of these blends would be thermodynamically miscible?
(a) PP-EPDM (b) PP-PVC (c) NBR-PVC (d) NR-BR

(iv) Which of these rubbers has best low temperature flexibility?
(a) SBR (b) ECO (c) MVQ (d) FKM

(v) Which of these accelerators has maximum delaying action?
(a) MBT (b) CBS (c) ZDC (d) MBTS

(vi) Which of the following fillers possesses lowest average particle size?
(a) SRF (b) SAF (c) GPF (d) FEF

(vii) Which type of compound are the most staining type anti-oxidant
(a) Amine (b) Phosphate (c) Phenol (d) Carboxylic acid

(viii) Dry bonding agent used for textile-rubber bonded product is:
(a) Chemlok (b) Isocyanate (c) Brass (d) Hexa + Resorcinol

(ix) The unit of tenacity of a filament is:
a) Tex b) Denier c) g/Denier c) Pascal

(x) Which of the following oils possesses lowest aniline point?
a) Napthenic b) Aromatic c) Paraffinic d) Vegetable oil

(xi) Which rubber provides maximum abrasion resistance?
(a) NR (b) SBR (c) BR (d) PU

(xii) Which polymer exhibits maximum heat resistance properties?
(a) CR (b) NBR (c) EVA (d) IIR

(xiii) Which one is the heaviest filler in rubber compounds?
(a) Carbon black (b) China clay (c) Silica (d) Barytes

(xiv) ZnO is used as a curing agent for :
(a) EPDM (b) BR (c) NBR (d) CR

(xv) The term 'Mechanical Stability Time' is associated with :
(a) Aromatic0 oils (b) NR latex (c) Oil-extended polymers (d) None of above

(xvi) Which of these polymers shows lowest tackiness?
(a) NR (b) EPDM (c) NBR (d) SBR

(xvii) Best flame resistant rubber is :
(a) BR (b) IIR (c) Silicone (d) CR

(xviii) What is the basis of grading ISNR?
(a) Viscosity (b) Ash content (c) Dirt content (d) Cure rate

(xix) Which of these rubbers has maximum air impermeability?
(a) CR (b) CPE (c) Hypalon (d) IIR

(xx) Paraffinic oil is most suitable plasticizer for :
(a) NBR (b) SBR (c) Flouroelastomers (d) EPDM

(1 x 20) = 20

2. (a) Define PRI and state its significance as associated with natural rubber.

(b) What do you understand by the term ' scorch ' as used in rubber industry ? Mention factors contributing to scorch and describe steps to be taken to minimize this problem. What is Gutta percha?

(c) Describe briefly the production of pale crepe grade of NR from field latex.

(6 + 8 + 6= 20)

3.
(a) Outline the preparation of a general purpose styrene butadiene rubber.
(b) Compare the properties of SBR 1000 with SBR 1500.
(c) Why EPDM is better heat resistant than IIR?
(d) Mention advantages of BIIR over IIR.
(e) Suggest two curing systems for CR.

(8+3+3+3+3) = 20

4. (a) What do you mean by technologically compatible blend. Give an example of miscible plastic-plastic blend.
(b) What are the advantages of NR/BR blend over NR?
(c) Give examples of heat fugitive (thermo-reversible) crosslinks.
(d) What are the advantages of TPVs over TPEs.
(e) How does styrene and VA contents respectively influence properties of SBS and EVA ?

(4+3+3+4+6)=20

GROUP – B

5. (a) What are the main differences between the various types of furnace blacks now available?
(b) When is insoluble sulphur used for rubber curing?
(c) Explain the term 'structure' as applied to carbon black. How do you measure 'structure' of carbon black?
(d) Give one example of each of the following :
i) anti-oxidant, ii) ultra-fast accelerator iii) vulcanization activator iv) peptizer v) extender vi) blowing agent vii) tackifier viii) post vulcanization stabilizer ix) non-black non-reinforcing filler x) eco-friendly oil.

(4+2+4+10) = 20

6. (a) Calculate the weight in Kg of a solid sphere of 6 inch. diameter with the following compound:

Ingredients	phr	Sp. gr.	Cost/ Kg (Rs.)
NR	100	0. 93	210
ZnO	5	5. 56	120
St. Acid	2	0. 90	48
China Clay	40	2. 65	2
Whiting	60	2. 62	4
HAF Black	20	1. 80	80
M. Oil	10	0. 92	45
Antioxidant	1	1. 20	210
CBS	0. 9	1. 40	250
Sulphur	3	2. 10	10

What will be the compound cost of the sphere ?

(b) What modifications would suggest in above compound formula to achieve (i) faster cure, (ii) higher tensile strength and (iii) higher hardness without increasing its specific gravity.

(c) What do you mean by EV system of curing as applied to NR compounding? Discuss briefly.

(10 + 6 + 4= 20)

7.

(a) What are meant by the terms Tex, Denier and Tenacity as applied to textiles?
(b) Calculate the linear density and tenacity of a yarn when 500 cm. of that yarn weighs 5 gms. and its breaking load is 10 gms.
(c) What is twist? What is its importance in textile application?
(d) Discuss briefly the structural aspects of use of textile either in tyres or in conveyor belting.

(6+5+4+5)= 20

8. Write short notes on: (**any <u>four</u>**):

(a) Flame retardants
(b) Silica based reinforcing filler
(c) Cotton vs. nylon as textile material for rubbers
(d) Manufacture of crumb rubber
(e) Factice
(f) Pre-vulcanised latex

(4 x 5) = 20