

B. Voc Rubber Technology Program
Tripura University (A Central University)

Course Curriculum: B. Voc in Rubber Technology
Curriculum Structure

SEMESTER – I
(NSQF Level 4/ Job Role: Rubber Technician)

Course Code	Course name	L	T	P	C
General Education: 16 Credits					
BVG-101	Communication Skill	4	0	0	4
BVG-102	Basics of Computer	4	0	0	4
BVG-103	Concept of Business	4	0	0	4
RT-101	Basics of Rubber	4	0	0	4
Skill Based Education: 14 Credits					
RTS- 101	Soil Chemistry for Rubber: Theory	2	0	0	2
RTS-102	Latex Collection & Preservation	0	0	4	4
RTS-103	Latex Coagulation & Rubber Sheet Preparation	0	0	4	4
RTS-104	Soil Testing: Lab	0	0	4	4
SEMESTER TOTAL:		18	0	12	30

SEMESTER – II
(NSQF Level 5/ Job Role: Rubber Associate)

Course Code	Course name	L	T	P	C
General Education: 08 Credits					
BVG-201	Entrepreneurship	4	0	0	4
RT-201	Latex Compounding: Materials, Methods & Testing Procedure	4	0	0	4
Skill Based Education: 22 Credits					
RTS- 201	Testing Method: Raw Material/ Finished Product (Industry)	0	0	4	4
RTS-202	Latex Compounding Testing: Raw Material / Finished Product	0	0	4	4
RTS-203	Latex Product Manufacturing	0	0	4	4
RTS-204	Industrial Training: Lab Chemist – Incoming Raw Material/ Finished Product	0	0	4	4
RTP- 201	Project – I	0	0	4	4
RTP-202	Report Writing & Presentation	0	0	2	2
SEMESTER TOTAL:		08	0	22	30

SEMESTER – III
(NSQF Level 6)

Course Code	Course name	L	T	P	C
General Education: 16 Credits					
BVG-301	Advanced Communicating English & Soft Skill	4	0	0	4
RT-301	Basics of Polymer Chemistry	4	0	0	4
RT-302	Basics of Rubber Science and Additives	4	0	0	4
RT-303	Statistical Methods	4	0	0	4
Skill Based Education: 14 Credits					
BVGS-301	Communication Skill-Lab	0	0	2	2
RTS-301	Raw Materials Testing (Additives): Industry	0	0	4	4
RTS-302	Raw Material Rubber Testing: Industry	0	0	4	4
RTS-303	Statistical Methods (Practical)	0	0	4	4
SEMESTER TOTAL:		16	0	14	30

SEMESTER – IV
(NSQF Level 6/ Job Role: Rubber Specialist)

Course Code	Course name	L	T	P	C
General Education: 08 Credits					
RT-401	Synthetic Rubber, Blending and manufacturing of Rubber Products	4	0	0	4
RT-402	Tyre and Tube production- Theory	4	0	0	4
Skill Based Education: 22 Credits					
RTS-401	Latex: Collection, Processing and Storage	0	0	4	4
RTS-402	Manufacturing Process: Latex and Rubber Products	0	0	6	6
RTS-403	Quality check, Problem Identification and Testing	0	0	4	4
RTS-404	Concepts of Pricing	0	0	4	4
RTS-405	Health and Safety Issues	0	0	2	2
RTP-401	Report Writing & Presentation	0	0	2	2
SEMESTER TOTAL:		08	0	22	30

SEMESTER – V
(NSQF Level 7)

Course Code	Course name	L	T	P	C
General Education: 16 Credits					
RT-501	Rubber Processing Instruments	4	0	0	4
RT-502	Rubber to Metal Bonded Products	4	0	0	4
RT-503	Sales & Purchase	4	0	0	4
RT-504	Entrepreneurship Skill	4	0	0	4
Skill Based Education: 14 Credits					
RTS-501	Mixing of Rubber	0	0	2	2
RTS-502	Material handling, weighing and Compounding	0	0	4	4
RTS-503	Manufacturing of Rubber Products	0	0	4	4
RTS-504	Testing of Rubber Products	0	0	4	4
SEMESTER TOTAL:		16	0	14	30

SEMESTER – IV
(NSQF Level 7/ Job Role: Rubber Technologist)

Course Code	Course name	L	T	P	C
General Education: 08 Credits					
RT-601	Advanced learning on product manufacturing & Reverse Engineering	4	0	0	4
RT-602	Tyre retreading & Reclaiming	4	0	0	4
Skill Based Education: 22 Credits					
RTS-601	Quality check: Rubber & Rubber Products	0	0	4	4
RTS-602	Industry Project in rubber product manufacturing industry	0	0	12	6
RTP-601	Report Writing & Presentation	0	0	6	4
SEMESTER TOTAL:		08	0	22	30

Program outcomes (PO)

India is the 4th largest producer and 2nd largest consumer of natural rubber in the world. The rubber industry comprise of tyre and non-tyre industries with a turnover of Rs.63,000 crore in 2011-12. The Indian rubber industry consists of around 6,000 units including large, medium and small industries. There is huge demand of skilled man power to serve these industries. So keeping in mind the huge demand of skilled workers Tripura University (A Central University) launched B. Voc Rubber Technology program in collaboration with National Skill Development Corporation (NSDC) and Rubber Skill Development Council (RSDC), New Delhi. The course is approved by UGC and is equivalent to any bachelor degree course. This is job oriented course with placement opportunity of the students at various rubber industries and Govt. Enterprises in India. In addition, Tripura University has been awarded as the first University in India to tie up with Industry by the Rubber Skill Development Council (RSDC), New Delhi.

The program is designed to impart hands-on training to students starting from rubber plantation, latex collection, and rubber sheet preparation to rubber product manufacturing. MoUs have been signed with various institutes and organization like Rubber Board, AIRIA, RSDC etc for providing skill based training to the students.

POs

1. Apply knowledge of rubber science and technology in rubber processing and product manufacturing
2. Ability to give guidance in identification of various raw materials used in the rubber industry
3. Able to provide assistance in achieving uniformity, consistency in the production intermediate or final product
4. Knowledge of Material Safety Data Sheet (MSDS)
5. Aware about different safety devices (safety bar, safety guard etc) attached with different rubber processing machineries and other safety norms of rubber and allied industries.
6. Communicate effectively on industrial activities and able to understand and write reports and maintain proper documentation, make effective presentations, and able to disseminate clear instructions.
7. Identify, formulate and review research literature in identification of problems related to rubber processing and troubleshooting the process or quality related issues.
8. Apply knowledge of professional ethics and responsibilities related to industrial best practices.
9. Work effectively as an individual and as well as a member in diverse and multidisciplinary teams.

PSO

PSO-1: To get knowledge about rubber and rubber chemicals, compound design, product formulation and development

PSO-2: Acquiring technical knowledge along with communication skill and entrepreneurial skills to establish own venture in rubber and allied fields.

1st Semester B. Voc Rubber Technology
General Education
Communication Skill
(4 Credits)
General Education Course Code: BVG-101

COURSE OUTCOMES

1. Able to Express statements, opinions or information clearly so that others can hear and understand
2. Learn about the skills of communication
3. Learn about the work in a team and other behavioral skills required to support the small group activities
4. Able to communicate with people in a form and manner and using language that is open and respectful
5. Able to resolve any difficulties in relationships with colleagues or get help from an appropriate person
6. Able to act objectively, rather than impulsively or emotionally when faced with difficult/stressful or emotional situations

Course Content

UNIT 1: INTRODUCTION TO PERSONALITY

Basics of personality, Human Growth and Behavior, Theories in personality, Motivation-Introduction to Motivation, relevance and Types of Motivation, Motivating the Subordinates, Analysis of Motivation

UNIT 2: COMMUNICATION AND PERSONALITY

Intrapersonal Communication and Body Language, Importance of Communication, Non Verbal Communication-Personal appearance, Posture, gesture, Facial expressions, Eye Contact, space Distancing, Interpersonal Communication and Relationship, Introduction to Interpersonal Relations, Analysis of Relations, Different Ego States, Analysis of Transactions-Strokes-Life Positions, Leadership skills, Introduction to Leaderships, Leadership Power, Leadership styles, Leadership in Administration, Team Building, Public speaking, Importance of Groups in organizations, Interactions in group, Decision taking, Team Building, Problem Solving.

UNIT 3: TECHNIQUES OF PERSONALITY DEVELOPMENT

Self Confidence, Mnemonics, Goal Setting, Immediate, short Term, Smart Goals, strategies, Time management, Planning, Individual Time Management Styles, Techniques, Techniques for Better Time Management.

UNIT 4: VOCABULARY

One-Word substitutions, Words Often Confused, Synonyms and Antonyms, Foreign Phrases, Phrasal Verbs, from dynamic Verbs-Go-Get-Run-Take-Look-Hold-Put-Stand etc, Concord, Articles, Prepositions, Words Followed by Prepositions, Tenses. Exercise—Essay Writing, Letter Writing, Cover Letter, Resume writing.

Recommended Books:

1. Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler, Crucial Conversations: Tools for talking When Stakes are High. McGraw Hill 2002.
2. R. Agarwal, Effective Communication Skills, Neha Publishers, 2008.
3. Matthew McKay, Martha Davis and Patrick Fanning, Messages: The Communication Skills Book, New Harbinger Publications, 2009.
4. Nageshwar Rao and Rajendra P. Das, Communication Skills, Himalaya Publishing House, New Delhi, 2009.

Basics of Computer
(4 Credits)
General Education Course Code: BVG-102

COURSE OUTCOMES

1. Provide foundation of basics of computer
2. Impart knowledge on Microsoft office
3. Impart working knowledge of Microsoft word, excel and power point
4. Understand the utility of Microsoft word, excel and power point
5. Impart knowledge on making data sheets and presentation of reports
6. Provide training on the use of internet and online searching operations

Course Content

Unit 1: Fundamentals of Computer

Introduction, Characteristics of Computers, Evolution of Computer, Generation of computer, Types of computers, Block diagram of a digital computer and detail function of each block, introduction to peripheral devices and memories, Hardware, Software, Software Categories, Relationship between Software and Hardware.

Unit 2: Office Packages

a) MS-Word: Salient features, Documentation Using MS-Word - Introduction and area of use, Menus and Commands, Toolbars and Buttons, Shortcut Menus, Wizards and Templates, Creating & Editing Document, Different Page views and layouts, Formatting Document, Auto-text, Autocorrect, Spelling and Grammar Tool, Document Dictionary, Paragraph and Page Formatting, Bullets, Numbering, Auto formatting, Bookmark, Printing and various print options, Finding and replacing of text, page set up, Header & Footer, Shapes, Equation editor, Drop Cap features, Water mark and Background color of the document, Paragraph settings, implementation of borders in both text and document, Insertion of images in the document from file and clip art, Advance Features of MS-Word-Mail Merge, Macros, Tables, File Management, Styles, inserting objects in the document, introducing text box in the document, linking and embedding object, Protection of the document using password.

b) MS-Excel: Salient features, Spread Sheet, Electronic Spread Sheet using MS-Excel – Introduction and area of use, Creating & Editing Worksheet, concept of cell, Finding and replacing of text in a cell, Auto fill feature, Shapes, Formatting and Essential Operations, Layout organization of excel worksheet, Formulas, Basic Excel Functions, Charts- Various types of charts like Bar, Column, Line, Pie etc., Insertion of images in the worksheet from file and clip art Advance features of MS-Excel- Linking and Consolidation, Creation of database, Database Management using Excel-Sorting, Filtering, Table, Validation, Goal Seek, Conditional formatting, inserting objects in the worksheet, introducing text box in the worksheet, Printing of work sheets and Work book with various options, Protection of the worksheet and workbook using password.

c) MS-PowerPoint: Salient features, Presentation using MS-PowerPoint- Automatic Presentations, Mouse click presentation, Concept of slides, Creation of Slides, Manipulating & Enhancing Slides with Lay Outs and Custom Background Effect, Inclusion of images in the Slides from file and clip art, Transition speed of Slides, Slide Sorter, Slide Master, Organizational Charts, Excel Charts, Word Art, Layering art Objects, Animations and Sounds, Custom Animation, Inserting Animated Pictures or Accessing through Object, Inserting Recorded Sound Effect or In-Built Sound Effect, Inserting video files in the slide, Custom Slide Show, Slide Show Set up, Page set up, Handout activity of slides- Handout orientation, Slides per page, Protection of the presentation using password.

Unit 3: Computer Network and Internet

Introduction to computer Network and its advantages, Elements of computer network, Server Client network, Peer to Peer network, LAN, MAN, WAN, Network topology, Introduction to Internet, Application of Internet in modern life, WWW, Web Browser, Browsing the Internet, Downloading and uploading capabilities of Internet, Search Engine, Various techniques for searching - double quotes,

Boolean operators, plus(+) sign, minus(-) sign, E-mail, Structure of the E-mail, Options/ Buttons of E-mail and their functional activities.

[**N.B.:-** Practical classes will be taken based on *Office Packages, Computer Network and Internet.*]

Recommended Books:

1. Fundamentals of Computers, P.K. Sinha, BPB Publications
2. Computer Fundamentals, B Rajaraman, PHI Publications
3. Computer Fundamentals. Reema Thareja, Oxford Publications
4. Office 2007, Microsoft Press
5. Office 2010/2013, Microsoft Press

CONCEPT OF BUSINESS

(4 Credits)

General Education Course Code: BVG-103

COURSE OUTCOMES

1. Learn the basic accounting principles
2. Impart knowledge on regulating expenditure (relating to technical changes) as per fund allocation
3. Learn to maintain records of the purchase/sale of machinery
4. Learn about the importance of maintaining records in proper manner
5. Learn about the calculation of taxes imposed

Course Content

UNIT 1: CONCEPT OF BANKING

Concept of-Bank, credit to deposit ratio (CDR), cash reserve ratio (CRR), statutory liquid ratio (SLR), repo rate, reverse repo rate, bank rate, prime lending rate, cheque, draft, open market operation (OMO), interest margin, equated monthly installment (EMI), debt service coverage ratio (DSCR), mortgage, pledge, hypothecation, know your customer (KYC), PradhanMantri Jan DhanYojna (PMJDY), Electronic clearing system (ECS), National electronic funds transfer (NEFT), real time gross settlement (RTGS), inflation.

Types of banks, role of central bank, functions of commercial banks, difference between commercial bank and central bank, different types of deposits, schemes of loans and application forms and filling, non-performing asset (NPA) and key provisions of Securitisation and Reconstruction of Financial Assets and Enforcement of Security Interest Act, (SARFAESI),2002.

UNIT 2: TAXATION

Concept of tax, purpose of tax, cannons of taxation, types of tax, assessee, person, assessment year, previous year, income, heads of income, sources of income, deduction from gross total income, total income, exempted income, rebate, relief, cess, surcharge, tax rates. Role of CBDT, permanent account number (PAN), consequence of quoting and non-quoting of PAN, types of assessment, Tax Deduction Account Number (TAN), Tax Deduction at Source (TDS), Collection of Tax at Source (TCS), different types of income tax forms, e-filing steps and precautions, appeals and revisions. Concept of indirect taxes- value added tax (VAT), sales tax, central sales tax, central value added tax, octroi, local tax, excise duty, import duty, export duty, service tax.

UNIT 3: ACCOUNTING

Book-keeping, Accounting, Accountancy, role of Accounting, types of accounts, golden rules, system of accounting, books of accounts, debit and credit, concept and conventions of accounting, accounting standards concept; books of primary records (journal), books of original records (ledger), test of arithmetical accuracy (trial balance), cash book and its types, bank reconciliation statement-concept and

preparation. Financial statements- concept, components, objectives and scope; Trading account, Profit & Loss statement, Balance Sheet-concept and preparation. Ratio Analysis-basic concept and applications.

Recommended Books:

1. Accounting For Management- Asish Kumar Bhattacharyya (Elsevier Publications,New Delhi)
2. Accounting For Management- Ambrish Gupta (Pearson Education, New Delhi)
3. Financial Accounting- Md. Hanif & Amitabha Mukherjee (McGraw Hill Publications,New Delhi).
4. Bank Management-Vasant Desai (Himalaya Publishing House)
5. Direct Taxes- V. K. Singhania& Monica Singhania (Taxmann Publications,New Delhi)
6. Direct and Indirect Taxes- S. K. Roy (ABS Publications, Kolkata)

Basics of Rubber

(4 Credits)

General Education Course Code: RT-101

COURSE OUTCOMES

1. To develop a basic understanding about the rubber (latex , natural and synthetic, reclaim)
2. To understand differences between different forms/ types /grades of rubber (sheet , block natural rubber, synthetic rubbers and Modified synthetic rubbers)
3. Impart knowledge on sources from where Rubber is available – Both Natural and synthetic
4. To understand the factors affecting the price of rubber
5. To understand the basic concepts and requirements of rubber plantation
6. To learn the different sources of information to remain updated about latest development in rubber related items

Course Content

Unit 1: History of Natural Rubber

Era of natural rubber

Mastication

Vulcanization

Unit 2: History of Synthetic Rubbers

Quest for synthetic rubber

Brief history of SBR, BR, Neoprene, nitrile, Butyl, Silicon

Unit 3: Concept of Rubber Science

Definition of rubber

Rubber elasticity

Rubber properties

Structure property relationship in rubber

Unit 4: Plantation

Introduction

Origin and distribution

Botany

Ecology & growing condition

Land & crop husbandry

Unit 5: Different kind of rubber industry

Pneumatic tires

Conveyer, V- belt, cable & hoses

Footwear, cellular & rubber molded products

Latex products & adhesives

Recommended Books:

1. Principles of Polymerization by George Odian, John Wiley & Sons, Inc., Hoboken, New Jersey, 2004.
2. Polymer science & Technology, P. Ghosh, Tata McGraw-Hill.
3. Rubber Basics, (Ed.) Richard B. Simpson, RAPRA Technology Limited, 2002.
4. Rubber Technology, (Ed.) Maurice Morton, Springer, 1999.
5. Natural Rubber: Biology, Cultivation and Technology, Vol. 23, (Eds.) M. R. Sethuraj and N.M. Mathew, Elsevier, New York, 1992.
6. Rubber Chemistry, J. A. Brydson, Applied Science Publishers Ltd., 1978.
7. Synthetic polymers, (Eds.) D. Feldman and A. Barbalate, Chapman & Hall, London, 1996.
8. Rubber Technology and Manufacture (second edition), (Ed.) C. M. Blow and C. Hepburn Butterworths, London, 1982.

**1st Semester B. Voc Rubber Technology
SKILL BASED EDUCATION**

Soil Chemistry for Rubber (Theory)

(2 Credits)

Skilled Based Education Course Code: RTS-101

COURSE OUTCOMES

1. Impart knowledge on Chemical composition of Soil
2. To impart knowledge on soil type, conditions, health and suitability for rubber plantation
3. Develop the complete understanding of the subject combining the theoretical and practical applications
4. Doubt clarification regarding types of soil and its testing procedures.
5. Able to calculate NPK requirement

Course Content

Unit 1: Basics of Soil

Formation of soils, its geology and mineralogy, Soil classification, Soil composition, Rubber soils of India and N. E. Region.

Unit 2: Soil Properties

Soil physical property – Texture, Structure, Depth, Drainage; Soil chemical property – Soil reaction, Organic matter, Cation exchange capacity, Fertility status; Soil biological property.

Unit 3: Soil fertility and nutrient management for rubber

Deficiency of nutrients in rubber, symptoms and remedy, Nutrient management, Types of fertilizers & their application and concept of DFR, Soil pollution and its implication

Recommended Books:

1. Physical and Chemical process of soil, D. Sarkar and Abhijit Haldar.
2. Fundamentals of soil science, Henry D Foth, Jhon Wiley & Sons, 1990.
3. Handbook of Soil Science, (Eds.) Pan Ming Huang, Yuncong Li, Malcolm E. Sumner, CRC Press, 2012.
4. Natural Rubber: Biology, Cultivation and Technology, Vol. 23, (Eds.) M. R. Sethuraj and N.M. Mathew, Elsevier, New York, 1992.
5. Natural Rubber: Agromanagement and crop processing, (Eds.) P. J. George and C. Kuruvilla Jacob, Rubber Research Institute, India.

Latex Collection and Preservation

(4 Credits)

Skilled Based Education Course Code: RTS-102

COURSE OUTCOMES

1. Know the tools and equipments used in the rubber harvesting
2. Understand the standard procedure of tapping

3. Understand the process involve in production of latex
4. Impart knowledge on Importance of handling & cleanliness in latex collection
5. Learn the procedure of storage and handling of field latex

Course Content

Unit 1: Basics of Latex

Definition of latex, Latex Stability, Classification of latex – Classification according to origin, Classification according to the chemical nature of the contained polymer, Classification according to the physical nature, NR & Synthetic lattices & their constitution. Types of NR lattices, Latex versus dry rubber.

Unit 2: Tapping

History of tapping, Tapping implements, Tapping method, Tapping frequency, Tapping cut, Tapping notations, Panel notation, Opening for tapping, Factors influencing tapping frequency, Intensive tapping, Puncture tapping, Factors influencing tapping efficiency, Tapping rest, Tapping panel dryness, Common tapping systems in India, Rainguarding.

Unit 3: Latex Collection

Hygiene in tapping and collection, Utensils for latex collection, Pre-processing of latex, Percoagulation, anticoagulants for short term preservation, Transportation,

Unit 4: Latex Preservation

Need for preservative, Action of preservative, Different type of preservative used for latex stabilization, Dosage of preservatives, Latex concentration processes – Evaporation, Electrodecantation, Creaming, Centrifugation, Standard specifications, Packing and dispatch.

Recommended Books:

1. Natural Rubber: Agromanagement and crop processing, (Eds.) P. J. George and C. Kuruvilla Jacob, Rubber Research Institute, India.
2. Natural Rubber: Biology, Cultivation and Technology, Vol. 23, (Eds.) M. R. Sethuraj and N.M. Mathew, Elsevier, New York, 1992
3. Elastomers and Rubber Compounding Materials, (Ed.) I. Franta, Elsevier, 1989.
4. Rubber Technology, (Ed.) Maurice Morton, Springer, 1999.

Latex Coagulation and Rubber Sheet Preparation

(4 Credits)

Skilled Based Education Course Code: RTS-103

COURSE OUTCOMES

1. Learn about the latex coagulation process
2. Impart knowledge on produces for rubber sheet preparation
3. Learn about the inspection and quality checking of rubber
4. Identify various type s/grades of natural rubber (EBC / RSS grade I . II , II , IV etc)
5. Able to follow the guidelines / MSDS(Material safety data sheet) for use
6. Learn procedures for storage, handling and transportation of rubber

Course Content

Unit 1: Coagulation of Latex

Processing of latex, Methods of coagulation/ destabilization of latex – Coagulation by acids, Coagulation by bases, Heat sensitized coagulation, Film formation and structure.

Unit 2: Method for rubber sheet preparation

Ribbed smoke sheet: Processing procedure, Coagulation, Sheeting and dripping, Drying – Smoking and smoke house, Solar-cum smoke drying, Sun drying, Air drying, Defects in rubber sheet due to microbial origin and other reasons, Inspection and grading.

Creep rubber preparation: Pale latex crepe, Sole crepe, field coagulum crepe, Drying, Defects, Grading and packing.

Unity 3: Specification of Rubber

Technically specified rubber, Production techniques, Machinery, Processing, Specification and grading.

Unit 4: Modifications and Applications of Latex

Physical modification of latex, Chemical modification of latex – Pre-vulcanized latex, Heveaplus MG graft polymers, Hydroxyl amine modified latex (HRH latex), Deproteinized latex, Compounding of Latex – vulcanizing agent, accelerators, anti-oxidants, fillers and pigments, viscosity modifiers. Latex products – Dipped latex products, Foamed latex products, Latex casting, Latex spreading.

Recommended Books:

1. Natural Rubber: Agromanagement and crop processing, (Eds.) P. J. George and C. Kuruvilla Jacob, Rubber Research Institute, India.
2. Natural Rubber: Biology, Cultivation and Technology, Vol. 23, (Eds.) M. R. Sethuraj and N.M. Mathew, Elsevier, New York, 1992
3. Elastomers and Rubber Compounding Materials, (Ed.) I. Franta, Elsevier, 1989.
4. Rubber Technology, (Ed.) Maurice Morton, Springer, 1999.
5. Rubber Technology and Manufacture (second edition), (Ed.) C. M. Blow and C. Hepburn Butterworths, London, 1982.

Soil Testing (Lab)

(4 Credits)

Skilled Based Education Course Code: RTS-104

COURSE OUTCOMES

1. Able to apply theoretical knowledge on soil for practical purpose
2. Arrangement of field visit and training program in Rubber Board
3. Impart hands-on training on soil testing
4. Impart knowledge on report writing and documentation

Course Content

1. Soil profile study and collection of soil
2. Textural analysis of soil
3. Soil moisture study
4. Soil pH and conductivity
5. Soil OC, N, P, K
6. Critical values for N, P, K under rubber soils and fertilizer recommendation.

Recommended Books:

1. Introduction to soil chemistry: analysis and instrumentation, Alfred R. Conklin, Jr. John Wiley & Sons, Inc., 2005.
2. Physical and Chemical process of soil, D. Sarkar and Abhijit Haldar.
3. Fundamentals of soil science, Henry D Foth, John Wiley & Sons, 1990.
4. Handbook of Soil Science, (Eds.) Pan Ming Huang, Yuncong Li, Malcolm E. Sumner, CRC Press, 2012.

2nd Semester B. Voc Rubber Technology

GENERAL EDUCATION

Latex Compounding: Materials, Methods & Testing Procedure

(4 Credits)

General Education Course Code: RT-201

COURSE OUTCOMES

1. Learn about the latex compound preparation
2. Understand the functions of compounding ingredients
3. Learn the handling of ingredients based on MSDS
4. Prepare the latex based products like gloves, thread, adhesives etc
5. Able to test the latex compound and latex based products

Course Content

Preparation of aqueous dispersions and emulsions: Dispersion of solid, dispersing agents, Evaluation of dispersion, preparation of emulsions, Planetary mixer, turbo mixer, Jar mill, Ball mill or pebble mills, Indentation hardness tester for foam, flex resistance tester, Mechanical stability tester, difference between processing of latex and milled rubber. Gelation of Natural Latex: Zinc oxide solubility with pH, Heat gelling systems, Delayed action gelling system using sodium silicofluoride, significance of pH/time gelation cure foaming, frothing time cure, foam, viscosity, delayed action gelling, Outline of latex-moulding and casting processes, latex-moulding processes using plaster molds, latex-moulding processes using metal moulds, other latex-moulding and casting processes, after treatments for latex mouldings, castings and compounding, Determination of Viscosity, particle size, ash content, pH, colloidal stability-zeta-potential, Modulus, Tensile strength, Elongation, Tear strength, Hardness, Ageing properties, Abrasion properties etc.

Compounding materials: Vulcanizing agent-Sulphur, sulphur donor and other curative; Accelerators-Dithiocarbamate, Xanthates, Thiazoles and Thiouram; Anti-oxidant- Amine derivatives, Phenolic derivatives; Fillers & pigments-Inorganic fillers & Organic fillers; Surface active agents-Anionic surface active agents & Cationic surface active agents; Viscosity modifiers & protective colloids

Recommended Books:

1. Practicals in polymer Science, Siddaramaiah, CBS Publishers.
2. Modern Rubber Chemicals, Compounds and Rubber Goods Technology, Engineers India Research Institute (EIRI), India, 2010.
3. Understanding polymer Testing, Ulritch, Hanser.
4. Rubber Chemicals and Processing Industries, Engineers India Research Institute (EIRI Board), India, 2007.
5. Physical testing of Rubber, R. P. Brown, Springer, 2006.
6. H.Warson and C.A.Finch, Applications of synthetic Resin latices, Vol.1,2,3, John Wiley & Sons Ltd. 2001.

Entrepreneurship

(4 Credits)

General Education Course Code BVG-201

COURSE OUTCOMES

1. Learn the requirement of different factors of production: land, labour and capital
2. Learn to prepare business plan
3. Can arrange the processes for purchase, effective utilization and management of the resources
4. Able to sustain existing business and make continual improvements
5. Learn to arrange/organize related documents/information

Course Content

UNIT I BASICS OF ENTREPRENEURSHIP

Entrepreneurship: Concept, Functions, Need and Importance; Pros and cons of entrepreneurship; Process of entrepreneurship; Entrepreneur: Types of Entrepreneurs; Entrepreneurial Value: Values, Attitudes and

Motivation; Difference between Entrepreneur and Intrapreneur; Entrepreneurship in Economic Growth; Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION and BUSINESS PLANNING

Major Motives Influencing an Entrepreneur; Self Assessment of Qualities, Skills, Resources and Dreams; Problem identification, creativity and innovation; Business Plan Preparation and Execution; Challenges faced by women in Entrepreneurship; Entrepreneurship Development Programs: Need, Objectives.

UNIT III BUSINESS

Social Entrepreneurship: Concept and Importance; Risk taking: Concept, Types of business risks; Role of technology/ social media in creating new forms of firms, organizations, networks and cooperative clusters; Barriers to Entrepreneurship; Support structure for promoting entrepreneurship (various government schemes); Form of business entities, Formalities for starting a business.

Unit IV MARKET ANALYSIS

Market–Traditional and E-commerce: Concept and Role; Types of Business: Manufacturing, Trading and Services; Market Forces: Sellers, consumers and competitors; Strategy for Expanding Markets: Local to global; Marketing Mix: Concept and Elements: Pricing and Factors affecting pricing: Market Survey: Concept, Importance and Process.

Unit V RESOURCE MOBILIZATION

Types of Resources - Human, Capital and other Resources: Need of finance for business: Estimating Financial Resources required; Methods of meeting the financial requirements: Venture capital funds, Fund raising: Financial market, stock exchange; Size and capital based classification of business enterprises; Various sources of Information; Selection and utilization of human resources and professionals like Accountants, Lawyers, Auditors, Board Members, etc: Role and Importance of a Mentor;

UNIT VI ENTREPRENEURS SUSTAINABILITY

Sickness in small Business – Concept, Magnitude, causes and consequences, Reasons for business failure, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, franchising, Merger and acquisition.

Recommended Books:

1. S.S.Khanka “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
2. Donald F. Kuratko, “Enterprenuership – Theory, process and practices”, Cengage Learning 9th Ed., Australia, 2012.
3. Hisrich R D and Peters M P, “Entrepreneurship” 5th Ed. Tata McGraw-Hill, 2002.
4. Mathew J Manimala,” Enterprenuership theory at cross roads: paradigms and praxis”
5. Dream tech 2nd edition 2006.
6. Rabindra N. Kanungo “Entrepreneurship and innovation”, Sage Publications, New Delhi, 1998.
7. David A. Harper, “Foundations of entrepreneurship and economic development” Routledge: Taylor & Francis Group, London, 2003.
8. Marc J. Dollinger, “Entrepreneurship: strategies and resources”, Marsh Publication, USA, 2008.
9. V. Havinal,”Management and Entrepreneurship”, New age international publishers, New Delhi, 2009.

Skilled Based Education **2nd Semester B. Voc Rubber Technology**

Testing Methods: Raw Material/ Finished Product
(4 Credits)

Skilled Based Education Course Code: RTS-201

COURSE OUTCOMES

1. Identify various raw materials used

2. Understands the importance of the quality of materials
3. Learn the testing procedures of the raw materials
4. Learn the analysis of data obtained
5. Learn the report writing related to testing results

Course Content

I. Raw material testing: Ash content, Fineness, Purity, Viscosity, Mechanical Stability test, KOH number test, Surface tension, zinc oxide viscosity test, zinc oxide thickening test, pH value, Volatile fatty acid (VFA), determination of gelling pH, determination of total copper, determination of total iron, determination of total manganese, determination of total nitrogen

II. Finished product testing: Physical properties, Modulus, Tensile strength, Elongation, Hardness, Tear strength, Ageing properties, Abrasion properties

Recommended Books:

1. Rubber Analysis – Polymers, Compounds and Products by M. J. Forrest, Rapra Technology Ltd., Volume 12, No. 7, 2001.
2. Principles of instrumental Analysis, Skoog, Thomson.
3. Polymer Lattices, D.C.Blackely, Vol 1,2 & 3, Applied Sciences publishing, London, 1997.
4. H.Warson and C.A.Finch, Applications of synthetic Resin latices, Vol.1, 2, 3, John Wiley & Sons Ltd. 2001

Latex Compounding and Testing: Theory and Practical (4 Credits)

Skilled Based Education Course Code: RTS-202

COURSE OUTCOMES

1. Learn about the various compounding ingredients
2. Learn the compounding procedures
3. Understands the various mixing procedures
4. Learn the latex product manufacturing techniques
5. Able to perform the testings of latex products

Course Content

Unit I: Compounding materials: Introduction, vulcanizing agents, vulcanization accelerators, vulcanization activators, anti-oxidants, Softeners, Fillers and pigments, Thickening and wetting agents (surface active substances), viscosity-modifiers and stabilizers, other latex compounding ingredients.

Unit II: Latex compounding design for dipped goods, Latex foams, Fibre latex product (Latex treated coir fibre), Latex extruded products.

Unit III: Testing procedure of the compounded materials: Wettability, Tensile, Elongation, Tear strength, Hardness, Aging test, Abrasion resistance etc.

Recommended Books:

1. High Polymer lattices Vol. I, II & III – D.C. Blackley, Applied Sciences publishing, London, 1997.
2. Latex in Industry – R. J. Noble
3. Latex manual – ICI Hand book
4. Rubbery material – J. Brydson, Elsevier Applied Science, London, 1988.
5. Latex Technology by D. Kumar and R. Chandra, Dhanpat Rai & Co. (2001).

Latex Product Manufacturing
(4 Credits)
Skilled Based Education Course Code: RTS-203

COURSE OUTCOMES

1. Learn the types of latex products and their compounding ingredients
2. Prepare the formulation of different latex products
3. Prepare the dipped latex goods
4. Able to understand the manufacturing procedure of extruded products
5. Understand the safety needs and latex allergy

Course Content

I. Introduction: Different types of latex products and their compounding ingredients

II. Compounding, Properties and formulations of —

- Dipped rubber products like: gloves, balloon, toys etc: Types of dipping process, Manufacturing process, Quality control, Defects and remedies.
- Adhesives: Formulatory ingredients, Testing of the quality of adhesive.
- Latex thread: Production process, Testing of latex thread, Technical specification
- Latex spreading: Carpet backing.
- Foam articles: Dunlop and Talalay process for Latex foam manufacturing
- Latex Allergies: Introduction, causes, remedies, types of latex reactions and allergy, Diagnosis of latex allergy.

Recommended Books:

1. Practical guide to latex technology, Rani Joseph, Smithers Rapra Technology Ltd., UK, 2013.
2. High Polymer lattices Vol. I, II & III – D.C. Blackley, Applied Sciences publishing, London, 1997.
3. Latex in Industry – R. J. Noble
4. Latex manual – ICI Handbook
5. Rubbery material – J. Brydson, Elsevier Applied Science, London, 1988.
6. Natural Rubber Science & Technology By: Roberts.

Industrial Training: Lab Chemist – Incoming Raw Material/ Finished Product
(4 Credits)

Skilled Based Education Course Code: RTS-204

COURSE OUTCOMES

1. Get the exposure of latex product manufacturing industries
2. Understand the working of latex industries
3. Understand the procedures of large scale production
4. Get hands-on experience of manufacturing
5. Learn the testing procedures and report writing

Course Content

- ✓ Student shall visit latex processing and product manufacturing company and there they will learn all the testing and physical properties related to latex and latex based products.
- ✓ They will get Hands-on experience on various testing procedures latex and latex based products.

Project-I

(4 Credits)

Skilled Based Education Course Code: RTP-201

COURSE OUTCOMES

1. Understand the working procedures
2. Able to apply the acquired knowledge
3. Able to summaries the procedures
4. Understand the applications of different ingredients
5. Acquire skill from the industrial training

On the basis of Industrial visit/training and may be on the basis of other skill based training, student shall write a project report and submit it to the concerned faculty.

Report Writing & Presentation

(2 Credits)

Skilled Based Education Course Code: RTP-202

COURSE OUTCOMES

1. Understand the importance of report writing and presentation
2. Learn the applications helpful for the report writing
3. Learn computer skills for presenting the report
4. Able to give inference from the finding
5. Able to give to the outcome from the report

Course Content

- ✓ Training on Data Analysis and Interpretation
- ✓ Training on Scientific Report Writing and Presentation
- ✓ Student shall write a complete report on skill based training and make a power point presentation to present in the department for evaluation.

3rd Semester B. Voc Rubber Technology

GENERAL EDUCATION

Advanced Communicating English & Soft Skill

General Education Course Code: BVG-301

COURSE OUTCOMES

1. Express ideas clearly through written / verbal communication
2. Able to fill up appropriate forms in paper or in computer
3. Able to prepare notes, diagrams, graphs, reports and projects
4. Understand & respond appropriately to any queries
5. Read and understand the course content

Course Content:

Unit I: Applied Grammar: Common errors, Use of words, Synonyms and Antonyms, Formation of words- Prefixes and Suffixes.

Unit II: Presentation of Technical Information: Technical description of – (a) Simple Objects, tools and appliances (b) Processes and Operation (c) Scientific Principles.

Unit III: Composition: Comprehension, Dialogues- Conversational and Colloquial, Idioms; Spoken English: Practice in self expression talks, Lecture and Speeches; Written Communication: note making and note taking; summarizing; notes and memos; developing notes into text; organization of ideas: cohesion and coherence; paragraph writing: ordering information in space and time; short essays:

description and argument; comparison and contrast; illustration; using graphics in writing: tables and charts; diagrams and flow-charts; maps, plans and graphs.

Unit IV: writing a rough draft; editing and proof reading; writing the final draft; styling text; filling in complex forms; standard letters; CV; writing a report; writing leaflets and brochures; writing references; essay writing.

Recommended Books:

1. High School English Grammar and Composition, P.C. Wren and H. Martin, S. Chand Company, New Delhi, 2017.
2. Advanced Grammar in Use (3Ed.), Martin Hewings, Cambridge University Press, 2013.

Basics of Polymer Chemistry General Education Course Code: RT-301

COURSE OUTCOMES

1. Learn basics on polymer (latex , natural and synthetic), their nomenclature
2. Learn the production of polymer from plantation and Chemical synthesis
3. Learn methods of polymerization and copolymerization
4. Understand the vulcanization procedures
5. Understand the effect of physical properties on the quality of polymemrs

Course Content:

Classification of Polymers: Natural and synthetic Polymers, Fundamentals of Biopolymers, Thermoplastics, Thermosets, Fibers and their Examples.

Monomers – Functionality – Types of polymerization, Mechanism of polymerization, Techniques of polymerization: bulk, solution, suspension, emulsion etc. Comparison of Emulsion and Suspension polymerization. Initiating systems: free radical, redox, cationic & anionic; living polymers, inifers, telechelics; Condensation polymerization- advantages & disadvantages, carothers equation. Copolymerization. Thermosetting polymers and Resins, Basics of Rubber Chemistry, Vulcanization- with Sulphur and without sulphur and their mechanism. thermoplastic polymers and Thermoplastic elastomers. Amorphous polymers: Glassy and Rubbery states; Glass transition Temperature and Factors affecting Glass Transition; Crystallinity and semi- crystalline state in polymers, crystal nucleation and growth: Spherulite formation; factors affecting crystallinity.

Recommended Books:

1. Principles of polymerization, G.Odion, Wiley Interscience
2. Textbook of polymer Science, F. W. Billmeyer, John Wiley & Sons.
3. Rubber Chemistry, J. A. Brydson, Applied Science Publishers Ltd., 1978.
4. Organic Polymer Chemistry (2Ed.), K. J. Saunders, Chap and Hall, London, 1988.
5. Polymer Science & Technology, J. R. Fried, Prentice Hall
6. Polymer science, V.R. Gowariker, New Age International
7. Synthesis of polymers, D. Schluter, Wiley VCH

Basics of Rubber Science and Additives General Education Course Code: RT-302

COURSE OUTCOMES

1. Able to ensure quality of materials as per the specified standards
2. Understand the function/s and its impact of each ingredient on the green and cured rubber
3. Understand the end properties of mixed compound/product
4. Know the chemicals used in rubber compounding
5. Know the safety norms while handling rubber chemicals

Course Content:

Unit I: Rubber properties: Introduction, Molecular nature of Rubber Elasticity, viscoelasticity, Creep and stress relaxation, Gough-Joule effect-thermodynamic study, stress/strain, hysteresis.

Unit II: Structure-properties relationship in Rubber: Introduction, Structure and Rubber properties, chain flexibility, network, Non-rubbery properties: Heat resistance, low temperature resistance, solution properties, electrical properties, structure and processing properties, strength of rubber.

Unit III: Mastication and peptiser, mastication process, vulcanization and vulcanization chemicals: vulcanization process, change of properties of elastomers depending on degree of polymerization, sulphur and sulphur containing vulcanizing agent, accelerator, accelerator activator, vulcanization retarder, aging and aging protector (Antioxidant)

Unit IV: Fillers and pigments: Reinforcing filler, non-reinforcing filler, effect of filler on elastomer, primary & secondary structure, filler activity: Bound rubber, particle size, filler surface determination, pH value, carbon black and its types, Pigments: White pigments, organic and inorganic colour pigments.

Unit V: Plasticization, plasticization process aids, oils & its types, uses, other plasticisers, blowing agent, mould releasing agent etc.

Recommended Books:

1. Rubber Compounding: Chemistry and Applications, (Ed.) B. Rodgers, Marcel Dekker Inc, 2004.
2. Rubber Technologist's Handbook (Vol. 2), (Eds.) J. White, S. K. De and K. Naskar, Smithers Rapra Technology Limited, 2009.
3. Rubbery Materials and their Compounds, (Ed.) J. A. Brydson, Elsevier Applied Sciences, 1988.
4. Rubber Chemicals and Processing Industries, Engineers India Research Institute (EIRI Board), India, 2007.
5. Modern Rubber Chemicals, Compounds and Rubber Goods Technology, Engineers India Research Institute (EIRI), India, 2010.

Statistical Methods

(4 Credits)

General Education Course Code RT-303

COURSE OUTCOMES

1. Learn the basics of statistical methods
2. Able to present the data using proper representation methods
3. Able to Follow statistical quality control procedures as per SOP
4. Able to calibrate /verify/validate the testing procedures
5. Understand the statistical analysis of the testing results

Course Content:

Unit 1: Collection, Organization and Presentation of Data

Sources and Collection of data, Random sampling and Non-random sampling; Errors; Classification of data; Frequency distribution; Frequency array; Uni and bivariate frequency distribution; Textual or Descriptive presentation, Tabular presentation and Diagrammatic & Graphical Presentation; Classifications: Qualitative, quantitative, temporal and spatial.

Unit 2: Measurement of various parameters

Measure of central tendency: Mean, Median, Mode; Dispersion: Range, Quartile deviation, Mean deviation and Standard deviation; absolute and relative measures of dispersion; Lorenz Curve; Skewness

And Kurtosis; Chi-square distribution; Testing of fit: Some important Theoretical Distributions-Binomial Distribution, Poisson Distribution.

Unit 3: Probability

Introduction; Definition and basic concepts; Definitions of Probability; Addition theorem on probability; Conditional Probability; Multiplication theorem on Probability; Bayes' theorem; Basic principles of permutation and combination.

Unit 4: Correlation, Index Number and Statistical Theories and application

Correlation-its type; Measurement of Correlation- Scatter diagram; Properties of correlation, Karl Pearson's coefficient of correlation; Spearman's rank correlation.

Unit 5: Test of significance of large and small samples

Introduction; Parameter and statistic; Sampling Distribution; t-Test; Standard Error; Null hypothesis and Alternative hypothesis; Level of significance and critical value; Error Analysis; Test Procedures; Analysis of Variance.

Recommended Books:

1. Bhat B.R., Srivenkataramana T. and Rao Madhava K.S. (1996): Statistics, A Beginner's Text, Vol. I and II, New Age International (P) Ltd.
2. Rohtagi, V.K. (1967) An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
3. Goon A.M., Gupta M.K. and Das Gupta B. (1991): Fundamental of Statistics, Vol. I, World Press, Calcutta
4. Cochran W.G. (1977) :Sampling Techniques, John Wiley and Sons, New York

Skill Based Education

Communication Skill-Lab

(2 Credits)

Skilled Based Education Course Code: BVGS-301

COURSE OUTCOMES

1. Able to prepare resume, project report etc.
2. Record details accurately in an appropriate format
3. Get the knowledge of different methods of recording information
4. Understands the procedures for reporting to the appropriate authority
5. Learn the presentation of work done in effective manner

Course Content:

UNIT I Resume / Report Preparation / Letter Writing

Letter writing –Job application with Resume - Project report - Email etiquette.

UNIT II Presentation skills

Elements of effective presentation – Structure of presentation - Presentation tools –Body language.

UNIT III Soft Skills

Time management – Stress management – Assertiveness – Negotiation

Strategies, Self introduction and Introducing Others – Greetings – Apologies – Requests – Social and Professional Etiquette - Telephone Etiquette.

UNIT IV Group Discussion

Group discussion as part of selection process, Structure of group discussion –Strategies in group discussion – Mock group discussions, Extempore- Public Speaking

UNIT V Interview Skills

Kinds of interviews – Interview techniques – Corporate culture – Mock interviews.

Recommended Books;

1. High School English Grammar and Composition, P.C. Wren and H. Martin, S. Chand Company, New Delhi, 2017.

2. Advanced Grammar in Use (3Ed.), Martin Hewings, Cambridge University Press, 2013.

Raw Materials Testing (Additives): Industry (4 Credits)

Skilled Based Education Course Code: RTS-301

COURSE OUTCOMES

1. Get the knowledge of rubber additives used in latex product manufacturing
2. Understand the testing procedures
3. Able to draw inference from the testing
4. Get hands-on experience of testing procedures
5. Learn the reporting of the final results

Course Content

Testing of Raw material:

Melting point, Dropping point, Volatile substance, dries mass, ash, Refractive index, Viscosity, Carbon Blacks testing – Determination of pH of carbon black (boiling slurry and sonic slurry), determination of volatile substances, ash content,

Recommended Books;

1. Physical testing of Rubber, Brown, Springer
2. Polymer science, Bahadur & Sastry, Narosa Publishers
3. Practicals in polymer Science, Siddaramaiaho, CBS Publishers.
4. Principles of instrumental Analysis, Skoog, Thomson Press.
5. Introduction to Thermal Analysis, Brown, Springer India.

Raw Material Rubber Testing (4 Credits)

Skilled Based Education Course Code: RTS-302

COURSE OUTCOMES

1. Get the exposure of testing of raw rubber
2. Understand the machinery operations with respect to each of the process
3. Learn the parameter setting for different machines
4. Get hands-on experience of testing procedures
5. Able to prepare samples per requirements of the testing

Course Content

Raw rubber and vulcanizate testing:

Mooney viscosity

Cure time, cure rate

Density of Rubber and Rubber Compound

Hardness

Resilience

Tensile properties

Glass transition temperature

Thermal stability and Aging test.

Recommended Books;

1. Physical testing of Rubber, Brown, Springer
2. Polymer science, Bahadur & Sastry, Narosa Publishers
3. Practicals in polymer Science, Siddaramaiaho, CBS Publishers.
4. Principles of instrumental Analysis, Skoog, Thomson Press.

5. Introduction to Thermal Analysis, Brown, Springer India

Statistical Methods (Practical)

(4 Credits)

Skilled Based Education Course Code: RTS-303

COURSE OUTCOMES

1. Learn practical and applied aspect of statistics
2. Understand the use of various statistical methods
3. Get hands-on experience of statistical analysis
4. Able to prepare samples for analysis
5. Understands and able to apply the theoretical knowledge on statistics

Course Content

1. Measure of Central Tendency and Dispersion
2. Probability Theory
3. Method of Least Square and Regression Analysis
4. t-Test, F-Test, Chi square Test, Z-Test
5. Analysis of Variance (ANOVA) Test

Recommended Books:

1. Bhat B.R., Srivenkataramana T. and Rao Madhava K.S. (1996): Statistics, A Beginner's Text, Vol. I and II, New Age International (P) Ltd.
2. Rohtagi, V.K. (1967) An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
3. Goon A.M., Gupta M.K. and Das Gupta B. (1991): Fundamental of Statistics, Vol. I, World Press, Calcutta
4. Cochran W.G. (1977) :Sampling Techniques, John Wiley and Sons, New York

4th Semester B. Voc Rubber Technology

GENERAL EDUCATION

Synthetic Rubber and Blending

General Education Course Code: RT-401

COURSE OUTCOMES

1. Develop a basic understanding about the rubber
2. Learn various rubbers and its manufacturing processes
3. Understanding the usage of rubber in various applications
4. Learn basics machinery used in the rubber manufacturing
5. Understand rubber product operations and techniques

Course Content

Unit 1: Synthetic Rubber

Manufacture, compounding and processing of NR, ENR, SBR, BR, IR, IIR, BIIR/CIIR, CR, EPM/EPDM, NBR, HNBR, XNBR, SI.

Unit 2: Polymer Blends and Rubber like materials

Mixing Rubber-rubber & Rubber-plastic blends, rubber like materials, Elastomers types: polyolefin, block polyester, polyurethanes; powder rubbers; liquid rubbers, hard rubber & reclaimed rubbers, ACM, fluorocarbon, polyurethane rubbers, polypropylene oxide, polyethers, polyalkenylenes. polysulfide, epichlorodrin rubber. Ethylene based rubbers (EVA, Vamac and Hypalon).

Unit 3: Processes of manufacturing of Rubber Products

Mixing mills, internal mixer, Screw extruders, ram extruders & extrusion technology. Calendaring technology Molding : compression, transfer, flashless, injection moulding, mould shrinkage, mould lubrication & mould cleaning. Vulcanization other than mouldings-batch curing methods, continuous vulcanization methods. Application of steam and electrical heating system. Heating and cooling systems for Two-Roll Mixers, Internal Mixer, Extruder and Calendar.

Unit 4: Manufacturing of master batch and Rubber Products

Manufacturing of Eraser, Rubber Ball, Chappal, Door-mate, Rubber band, Tube, Tyre tread compound.

Recommended Books:

1. Developments in rubber technology—2 (Synthetic rubbers), (Eds.) A. Whelan and K. S. Lee, Applied Science Publishers Ltd., London, 1981.
2. Synthetic polymers, (Eds.) D. Feldman and A. Barbalate, Chapman & Hall, London, 1996.
3. Polymer Composites, Friedrich, Springer.
4. Current Topics in Elastomers Research, (Ed.) Anil K. Bhowmick, CRC Press, 2008.
5. Composite materials: Science & Engineering, Chawla, Springer India.
6. Polymer Blends & Composites, L.H. Sperling, Hanser.
7. Polymer Blends, Vol I & II, D.R. Paul, Academic Press.
8. Filled Polymers Science & Industrial Application, Leblanc, CRC press.

Tyre and Tube production (Theory)
General Education Course Code: RT-402

COURSE OUTCOMES

1. Able to Identify the different tools and equipments used in tyre and tube manufacturing
2. Understand process flow chart for the manufacturing of different type of tyres: Automobile and cycle/rickshaw/motorcycle/scooter /EM /OTR/Farmfor both Bias and Radial types of onstruction
3. Understanding of the process of component preparation for tyre building
4. Understanding the proves of bead wire extrusion and insulation
5. Learn the procedures of tube cutting, splicing, curing and process of valve application

Course Content

Unit 1: Various tyres and their features; Theoretical aspects related to tyre and tube manufacturing process; different types of tools, equipments , chemicals, products and machinery in use; Properties of rubber, compounds and finished product, Raw Materials, Process Machinery and equipments, health and safety issues

Unit 2: Different tools and equipments used in tyre and tube manufacturing; Understand the application of different tools and equipments used in the different processes and also life cycle of the tools used; Latest developments in the tools and equipments used in tyre and tube manufacturing; Identify and describe different machines used for various processes involved in manufacturing of different types of tyres.

Unit 3: Learn the procedures of tube cutting, splicing and curing; Understand the functioning of tools and equipments used in tube Mandrelling and demandrelling; Tube preparation prcess; process of valve application.

Unit 4: Rubber compounding and formulation for tyre and tube production, Testing compound rubber, Various defects in tyre and tube.

Recommended Books:

1. Developments in rubber technology—2 (Synthetic rubbers), (Eds.) A. Whelan and K. S. Lee, Applied Science Publishers Ltd., London, 1981.
2. Filled Polymers Science & Industrial Application, Leblanc, CRC press.
3. The Complete Book on Rubber Processing and Compounding Technology, NIIR Board Of Consultants, Engineers, Asia Pacific Business Press Inc., 2007.
4. Tyre Compounding for Improved Performance, M. S. Evans, RAPRA Publication, 2002.
5. Introduction to Tyre Technology, S. N. Chakravarty, Polym Consultants, New Delhi, 2015.

Skill Based Education

Latex: Collection, Processing and Storage

Skilled Based Education Course Code: RTS-401

COURSE OUTCOMES

1. Learn basics and techniques of latex collection
2. Get exposure to latex processing
3. Understanding the methods of sheet processing
4. Learn the method of scientific preservation of latex
5. Get knowledge on centrifuging machines and its operation and maintenance

Course Content

NR & Synthetic lattices & their constitution, Equipments used for the collection of natural rubber (NR) latex, Factors influencing tapping frequency, Intensive tapping, Puncture tapping, Factors influencing tapping efficiency, Tapping rest, Tapping panel dryness, rain guarding, Tapping techniques, Utensils for latex collection, Pre-processing of latex, coagulation, Transportation, Need for preservative, Action of preservative, Different type of preservative used for latex stabilization, Dosage of preservatives, Latex concentration processes – Creaming, Centrifugation, rubber sheet preparation and Specification of Rubber. Principles and practices in smoke drying of sheet rubber, sheet processing and scientific storage of sheets, different grades of the sheet and its usage, Procedures for storage/ handling of the Rubber sheets/block rubber.

Recommended Books:

1. Natural Rubber: Agromanagement and crop processing, (Eds.) P. J. George and C. Kuruvilla Jacob, Rubber Research Institute, India.
2. Natural Rubber: Biology, Cultivation and Technology, Vol. 23, (Eds.) M. R. Sethuraj and N.M. Mathew, Elsevier, New York, 1992
3. Elastomers and Rubber Compounding Materials, (Ed.) I. Franta, Elsevier, 1989.
4. Rubber Technology, (Ed.) Maurice Morton, Springer, 1999.

Manufacturing Process: Latex and Rubber Products

Skilled Based Education Course Code: RTS-402

COURSE OUTCOMES

1. Participate actively in the field visits, industrial visits and training programs
2. Develop the complete understanding of the subject combining the theoretical and practical applications
3. Ensure that all the doubts are clarified regarding the product, process and technology.
4. Understand operations and maintenance of effluent management system
5. Learn the safety norms while handling latex

Course Content

1. Preparation of emulsions.
2. Concentrating of natural rubber field latex
3. Effect of viscosity modifier on thickness of latex deposits.
4. Dipping Techniques
5. Preparation of rubber bands, balloons, finger caps, gloves, latex foam and latex based adhesives.
6. Production of rubber articles by casting.
7. Mixing of rubber
8. Preparation of eraser, chappal, doormat, rubber balls etc

Industry visits: Visit to industries producing dipped goods, latex thread, carpet backing, latex foam, Footware, cables, Tyre and Tyre trade etc.

Recommended Books:

1. Rubber technology and manufacture, 2nd ed., C. M. Blow and C. Hepburn, Eds., Butterworths, London, 1982.
2. Physical testing of Rubbers, J. R. Scott, Maclaren, 1965.
3. Physical testing of Rubbers (4th Ed.), R.P. Brown, Springer, 2006.
4. Indian standards
5. ASTM standards – Vol. 8 & 9 series
6. Mausser,R.F., The Vanderbilt Latex Hand book 3rd edn.,
7. Waterman,R., Mausser R.F., & Miller,E.E., Vanderbilt Latex Book on Process and Compounding Ingredients, Publ. By R T Vanderbilt.
8. Polymer Latices and their applications, Calvert, McGraw Hills, 1985.
9. H.Warson and C.A.Finch, Applications of synthetic Resin latices, Vol.1,2,3, John Wiley & Sons Ltd. 2001.

Quality check, Problem Identification and Testing Skilled Based Education Course Code: RTS-403

COURSE OUTCOMES

1. Understand the quality of mixing of rubber
2. Able to do the cost analysis of the rubber compounding
3. Ensure the quality and purity of the rubber and rubber chemicals
4. Able to estimate the oxidative ageing of the rubber
5. Learn the methods of quality check and inspection

Course Content

Mixing and Quality of Mixing, Compounding and testing of compounded Rubber, Different types of testing of rubber products, Testing of raw materials: Purity, viscosity, ash content, surface tension, Mooney viscosity, PRI, Determination of Viscosity, pH, Modulus, Tensile strength, Elongation, Tear strength, Hardness, Ageing properties, Abrasion properties etc; Product inspection and Quality check.

Recommended Books:

1. Physical testing of Rubber, Brown, Springer
2. Polymer science, Bahadur & Sastry, Narosa Publishers
3. Practicals in polymer Science, Siddaramaiah, CBS Publishers.
4. Principles of instrumental Analysis, Skoog, Thomson Press.
5. Introduction to Thermal Analysis, Brown, Springer India.

Concepts of Pricing Skilled Based Education Course Code: RTS-404

COURSE OUTCOMES

1. Learn and familiarize with the basic terms, concepts, approaches and problems of pricing decisions
2. Understand the key economic, analytical, and behavioral concepts associated with costs and pricing strategies
3. Understand and be able to apply advanced pricing techniques.
4. Understanding of pricing strategies of different products, lifecycles and companies.
5. Understand and analyze price strategies of competitors in indifferent market situations through case study scenarios.

Course Content

Unit I: Introduction to pricing, meaning and objectives of pricing, Cost of Production, Understand profit, break even and shut down conditions, Technology and pricing, relationship between average , marginal and total cost, concept of equilibrium price and revenue

Unit II: basic concepts of factors of production, concept of normal profits, supernormal profits and loss, Pricing methods: cost oriented pricing method and market-oriented pricing method

Unit III: Pricing: Significance. Factors affecting price of a product. Pricing policies and strategies, factors affecting the profitability of the organization

Unit IV: Material/inventory control techniques. Accounting and control of purchases, storage and issue of materials. Methods of pricing of materials issues — FIFO, LIFO, Simple Average, Weighted Average, Replacement, Standard Cost. Treatment of Material Losses

Unit V: Pricing Decisions: Major factors influencing pricing decisions, various methods of pricing, cost effectiveness of bringing in new techniques Concept of demand and supply of the product.

Recommended Books:

1. The Strategy and Tactics of Pricing (4th edition), Thomas Nagle and John Hogan, Prentice Hall, 2006
2. Buskirk, R.H., et al; Concepts of Business: An Introduction to Business System, Dryden Press, New York.
3. Neeru Kapoor, Principles of Marketing, PHI Learning
4. Pricing Strategies: A Marketing Approach, Robert M. Schindler, Rutgers University, Camden, USA, SAGE Publications, Inc, 2011.

Health and Safety Issues of Rubber Industries
Skilled Based Education Course Code: RTS-405

COURSE OUTCOMES

1. Undertake basic safety checks before operation of all machinery and equipment.
2. Read and understand the hazards of use and contamination mentioned on the labels of chemicals, utilities etc.
3. Dispose off waste safely and correctly in a designated area.
4. aware of first aid, evacuation and emergency procedures
5. Handle heavy and hazardous materials with care and using appropriate tools and handling equipment such as trolleys, ladders.

Course Content

Occupational health and safety measures of rubber industry; Personal hygiene, Product handling & storage, Spillages and disposal of waste material, Rubber dust and fumes- carbon black, silica, fumes during rubber curing; effect of N-nitrosamines; issues/problems related to mill safety, calender safety, fire & Explosion, machine lockout, Solvents-benzene, toluene, xylene, dichloromethane (DCM), trichloroethane, Latex allergy- skin irritation and dermatitis, First aid & medical facilities.

Able to understand the all operational safety norms (such as wearing protective gloves, masks and safety shoes) and on **following MSDS** (a must for each supplier), Manage first aid, general medication etc.

Know / keep Telephone no. of hospital and arrange for hospitalization in case of accident, Comply with health, safety, environment guidelines and regulations in accordance with international/national standards or the organizational standards.

Recommended Books:

1. Health and Safety in the Rubber Industry, N. Chaiear, Smithers Rapra Publication, UK, 2001.
2. Update on Health and Safety in the Rubber Industries, N. Chaiear and N. Saejiw, Smithers Rapra Publication, UK, 2010.
3. Chemical agents and related occupations, Volume 100 F, A review of human carcinogens, International Agency for Research on Cancer, WHO, France, 2012.

Report Writing & Presentation
Skilled Based Education Course Code: RTP-401

COURSE OUTCOMES

1. Able to use the computer applications for faster and efficient completion of tasks
2. Able to access and utilize internet for carrying out project work
3. Able to maintain records electronically
4. Record details accurately in an appropriate format

5. Collect information in an appropriate manner whilst following organizational procedures

Course Content

- ✓ Training on Data Analysis and Interpretation
- ✓ Training on Scientific Report Writing and Presentation
- ✓ Student shall write a complete report on skill based training and make a power point presentation to present in the department for evaluation.

5th Semester B. Voc Rubber Technology

General Education

Rubber Processing Instruments

(4 Credits)

General Education Course Code: RT-501

COURSE OUTCOMES

1. Understand process flow chart for the manufacture of various products : tyre and non-tyre
2. Understand the formation of uncured components/products and cured products
3. Able to relate each of the process step with respect to machine, material and manpower
4. Able to follow the importance of standard operating procedures on all units required for production of product
5. Able to understand all operational safety norms (such as wearing protective gloves, masks and safety shoes) and on following MSDS

Course Content

Use of measuring equipment- weighing scale, thermometer, pyrometer, measuring tape, vernier scale, screw gauge, tachometer, pressure gauge, timer, measurement of volume. Batch weight, specific gravity and cost of compound.

Working principle of different rubber processing instruments like rubber processing machineries (mixing mill, kneader, intermix, banbury, duplex/triplex/quadruplex extruders, hot/cold feed /pin barrel extruders, 2Roll/3Roll/4 Roll calenders, Dip Unit, Stock preparation and curing/moulding – hydraulic press, boot and shoe press, conveyor and V belt press, tyre/tube/flap curing press, autoclave, continuous curing, rotocure etc.

Safety measures of the instruments, Quality management, Disposal of wastes as per SOP and its importance, Awareness on Material Safety Data Sheet (MSDS).

Recommended Books:

1. Science and technology of rubber, (Eds.) James E. Mark, Burak Erman, Elsevier, Academic press, 2005.
2. Rubber Compounding: Principles: Materials, and Techniques (second edition), Fred W. Barlow, CRC Press, 1988.
3. The Complete Book on Rubber Processing and Compounding Technology, NIIR Board Of Consultants, Engineers, Asia Pacific Business Press Inc., 2007.
4. Rubber Technology and Manufacture (second edition), (Ed.) C. M. Blow and C. Hepburn Butterworths, London, 1982.
5. Technology of Rubber and Rubber Goods Industries, Engineers India Research Institute (EIRI), India.
6. Modern technology of extrusion & extruded products, EIRI, India

Rubber to Metal Bonded Products

(4 Credits)

General Education Course Code: RT-502

COURSE OUTCOMES

1. Able to understand the raw material, Plant machinery and equipment capability to produce the required quality product readiness before the commencement of manufacturing process
2. Able to identify and describe different machines used for various processes

3. Understand the use of ingredients in the compounding formulation for rubber to metal bonded products
4. Ensure appropriate use and minimum wastage of materials (as per standard provided) and utilities
5. Understand the curing process and quality check of rubber to metal bonded products

Course Content

Process of metal surface preparation: using chemical, Operation and using of different tools and instruments Specification tagging of Rubber and other materials, Compounding of rubber to be bonded, Methods of bonding/Bonding by Chemical application - ebonite bonding, brass plating, isocyanate bonding, use of rubber derivatives, surface cleaning of metal, Function of sand blasting machine and autoclave. Rubber strip placement on roller and movement of roller, Building of rubberized roller.

Knowledge of curing process, process and importance of quality checks, defects, removal of trapped air while making rubber to metal bonded product.

Quality checking, disposal and storage of materials, Standard procedures, Fillers, Processing Aids, Vulcanizing System, protective agents and special additives. Testing of bond.

Recommended Books:

1. The Complete Book on Rubber Processing and Compounding Technology, NIIR Board Of Consultants, Engineers, Asia Pacific Business Press Inc., 2007.
2. Rubber Technology and Manufacture (second edition), (Ed.) C. M. Blow and C. Hepburn Butterworths, London, 1982.
3. Technology of Rubber and Rubber Goods Industries, Engineers India Research Institute (EIRI), India.
4. Handbook of Rubber Bonding, B. Crowther, RAPRA Technology Limited, UK, 2003.
5. Rubber to Metal Bonding, Samuel Buchan, C. Lockwood, 1948.

5th Semester B. Voc Rubber Technology Skill Based Education

Mixing of Rubber (2 Credits)

Skilled Based Education Course Code: RTS-501

COURSE OUTCOMES

1. Understand the basics terms related to mixing
2. Understand the requirement of mastication and its steps
3. Get knowledge about different mixing machineries and its operation
4. Understand the working of the equipment and accessories
5. Understand the impact of operations on the final product

Course Content

Flow behavior-viscosity, Newtonian and non-Newtonian behavior, capillary and rotational viscometers, curing behavior, rheometry, Mastication and its steps, Rubber mixing mechanism - mixing machinery - two roll mill - internal mixer-machine design & operation, mixing in internal mixers & two roll mill, mixing cycles and procedures, operating variables and mix quality, Continuous mixers, Master batching, Batch vulcanization.

Recommended Books:

1. Science and technology of rubber, (Eds.) James E. Mark, Burak Erman, Elsevier, Academic press, 2005.
2. Rubber Compounding: Principles: Materials, and Techniques (second edition), Fred W. Barlow, CRC Press, 1988.
3. The Complete Book on Rubber Processing and Compounding Technology, NIIR Board Of Consultants, Engineers, Asia Pacific Business Press Inc., 2007.
4. Rubber Technology and Manufacture (second edition), (Ed.) C. M. Blow and C. Hepburn Butterworths, London, 1982.
5. Technology of Rubber and Rubber Goods Industries, Engineers India Research Institute (EIRI), India.

Material handling, weighing and compounding (4 Credits)

Skilled Based Education Course Code: RTS-502

COURSE OUTCOMES

1. Able to do the cost analysis of compound
2. Able to calculate the optimum quantity to be processed in a particular instrument
3. Able to maintain records of the work done
4. Able to correlate targeted properties with compounding ingredients and mixing procedure
5. Able to take corrective action for problems identified according to the

Course Content

Compound cost analysis and cost control: Calculation of compound cost of recipe, Calculation of compound volume, calculation of compound specific gravity of a recipe, Compounding for vulcanize properties: Productivity, Design compound for various rubber, formulation with target physical properties Order of addition, mixing procedures with examples, mixing procedures for specific compounds, mixing method of solid rubber and latex.

Recommended Books:

1. Rubber technology and manufacture, 2nd ed., C. M. Blow and C. Hepburn, Eds., Butterworths, London, 1982.
2. Physical testing of Rubbers, J. R. Scott, Maclaren, 1965.
3. Physical testing of Rubbers (4th Ed.), R.P. Brown, Springer, 2006.
4. Indian standards
5. ASTM standards

Manufacturing of Rubber Products

(4 Credits)

Skilled Based Education Course Code: RTS-503

COURSE OUTCOMES

1. Learn about the tools and equipments used in rubber and latex product manufacturing
2. Learn about the raw material required for production of rubber product
3. Understand the processes and machineries in use
4. Understand the functioning of various tools and equipments required at different stages of manufacturing
5. Understand the implications of quality variations in raw material on final product

Course Content

Overview of Rubber Product Processing, Natural and synthetic rubber, Categorical name of Rubber-Raw Rubber, Semi-manufactured product, Final product, Product Processing, Materials, machinery, mould, dies and process optimization for the manufacture of rubber products-Tyre, tube, hose, belts, cables, sports goods, footwear, molded and rubber to metal bonded products.

Stages of Processing in the manufacturing of Rubber Goods: Hose; Sheet, Shoes, Wire and Cable, Roll Covering, Gaskets, Conveyor Belts, Transmission Belts, Balls, Seals and O-Rings, Noise/Vibration and Shock Absorbers, Hot Water Bottles, Marine Fenders, Expansion Joints, Tracks and Membranes etc. Finishing of rubber products- Flash & spew removal, punching, grinding, other methods, halogenations.

Recommended Books:

1. Rubber Products Manufacturing Technology, (Eds.) Anil K. Bhowmick, Malcom M. Hall, Henry A. Benarey, Marcel Dekker, Inc, New York, 1994.
2. Rubber Technology and Manufacture (second edition), (Ed.) C. M. Blow and C. Hepburn Butterworths, London, 1982.
3. Rubber Compounding: Principles: Materials, and Techniques (second edition), Fred W. Barlow, CRC Press, 1988.
4. The Complete Book on Rubber Processing and Compounding Technology, NIIR Board Of Consultants, Engineers, Asia Pacific Business Press Inc., 2007.
5. Rubber Technology and Manufacture (second edition), (Ed.) C. M. Blow and C. Hepburn Butterworths, London, 1982.
6. Technology of Rubber and Rubber Goods Industries, Engineers India Research Institute (EIRI), India

Testing of Rubber Products

(4 Credits)

Skilled Based Education Course Code: RTS-504

COURSE OUTCOMES

1. Able to carry out quality checks and inspect to identify problems
2. Able to analyze and take corrective actions
3. Able to evaluate the need for action to ensure that problems do not recur
4. Able to Interpret the results of the quality check correctly
5. Review effectiveness of action taken after performing the required testing

Course Content

Standard for testing-ISO, DIN, BIS, ASTM, Guidelines of testing of rubber and rubber products (SOP), Testing and machinery:

Tensile test, Tear test & Elongation test- Tensile testing machine

Hardness test- Rubber hardness tester

Abrasion test- Abrader

Leak test (Testing of joints)- Leak test machine

Rheological test- Rheometer

Viscometer test- Viscometer

Dispersion test- Dispersion tester

Aging resistance test- Aging Oven Tester

Vibration test- Vibration Testing Machine

Burst strength testing- Burst Pressure Testing Machine

Thermal testing of rubber, Molecular weight determination, Spectroscopic analysis and morphology.

Recommended Books:

1. Physical testing of Rubbers, J. R. Scott, Maclaren, 1965.
2. Physical testing of Rubbers (4th Ed.), R.P. Brown, Springer, 2006.
3. Indian standards
4. ASTM standards

6th Semester B. Voc Rubber Technology General Education

Advanced learning on product manufacturing & Reverse Engineering (4 Credits)

General Education Course Code: RT-601

COURSE OUTCOMES

1. Understand the functioning of newly introduced tools and equipments required at different stages of manufacturing
2. Able to explain the possibility of using different raw material to enhance productivity and profitability
3. Able to check the relevance of introducing new machineries
4. Use different permutations and combinations of raw materials to carry out modifications in existing processes/product
5. Learn to conduct trials in the actual set up for developed modifications/improvisions

Course Content

Functions of basics tools and equipments used in Rubber Industry, Advanced system and machinery, Use of Raw materials- their productivity and profitability, Modification of existing process/product.

Maintenance work record, Experimental guidelines, Research Proposal, Procedures of research work, Data collection, analysis and documentation, Problem identification and solving, Defects and remedies of Rubber products, batch size and related calculation.

Quality check, Cost analysis of new product, Waste disposal, Safety norms, MSDS, First aids & General medication.

Recommended Books:

1. Reverse Engineering of Rubber Products: Concepts, Tools and Techniques (1st Ed.), Saikat Das Gupta, Rabindra Mukhopadhyay, Krishna C. Baranwal, Anil K. Bhowmick, CRC Press, 2013.
2. The Science & Technology of Rubber, Mark Erman & Eirich, Elsevier Academic press.
3. Rubber Products Manufacturing Technology, (Eds.) Anil K. Bhowmick, Malcom M. Hall, Henry A. Benarey, Marcel Dekker, Inc, New York, 1994.
4. Rubber Technology and Manufacture (second edition), (Ed.) C. M. Blow and C. Hepburn Butterworths, London, 1982.
5. Rubber Materials, R. Kothandaraman, CRC Press.

Tyre retreading & Reclaiming (4 Credits)

General Education Course Code: RT-602

COURSE OUTCOMES

1. Develop a basic understanding about the requirement for tyre retreading
2. Understand the processes involved in retreading tyres and the importance of using retread tyres
3. Learn the terminologies used in retread process\
4. Able to identify the tools and machinery used for retreading
5. Learn the procedure of buffing and inspection.

Course Content

Requirement for reclaim, Properties and application of reclaimed rubber, Method of manufacture, machines/equipments for cracking, grinding, refining and straining, sorting of different rubber components- tyre/non tyre/ butyl rubber, importance of segregating butyl rubber reclaim and its use, difference between natural, synthetic and reclaim rubber, Compounding aspect, Retreading process, Camel back or Tread rubber, Process of manufacturing of camel back, Cushion gum, Vulcanizing cement, Machineries used in retreading, hot and cold process for retreading, building and curing operation for retreaded tyre.

Recommended Books:

1. The Complete Book on Rubber Processing and Compounding Technology, NIIR Board Of Consultants, Engineers, Asia Pacific Business Press Inc., 2007.
2. Tyre retreading, B. Banerjee (Editor), Smithers Rapra Technology Ltd., UK, 2015.
3. Developments in rubber technology—2 (Synthetic rubbers), (Eds.) A. Whelan and K. S. Lee, Applied Science Publishers Ltd., London, 1981.
4. Filled Polymers Science & Industrial Application, Leblanc, CRC press.
5. Reverse Engineering of Rubber Products: Concepts, Tools and Techniques (1st Ed.), Saikat Das Gupta, Rabindra Mukhopadhyay, Krishna C. Baranwal, Anil K. Bhowmick, CRC Press, 2013.

6th Semester B. Voc Rubber Technology Skill Based Education

Quality Check: Rubber & Rubber Products (4 Credits)

Skilled Based Education Course Code: RTS-601

COURSE OUTCOMES

1. Able to ensure that total range of checks are regularly and consistently performed
2. Identify non-conformities to quality assurance standards
3. Identify potential causes of non-conformities to quality assurance standards
4. Take up the results of the findings within stipulated time
5. Able to record the results of actions taken

Course Content

Compounding Ingredients and Formulation, Chemical analysis of rubber, Determination of Acrylonitrile Content (ACN) of Acrylonitrile Butadiene Rubber (NBR), Thermal analysis- DSC:

Glass Transition Temperature, Tg, Melting and crystallization, Curing or vulcanization, Oxidation and Degradation, Specific Heat or Heat Capacity, TGA: Decomposition, stability and composition,

Recommended Books:

1. Rubber technology and manufacture, 2nd ed., C. M. Blow and C. Hepburn, Eds., Butterworths, London, 1982.
2. Physical testing of Rubbers, J. R. Scott, Maclaren, 1965.
3. Physical testing of Rubbers (4th Ed.), R.P. Brown, Springer, 2006.
4. Reverse Engineering of Rubber Products: Concepts, Tools and Techniques (1st Ed.), Saikat Das Gupta, Rabindra Mukhopadhyay, Krishna C. Baranwal, Anil K. Bhowmick, CRC Press, 2013.

Industrial Project-I & II

(6+6 Credits)

Skilled Based Education Course Code: RTS-602

COURSE OUTCOMES

1. Able to identify new and appropriate subject for project (related production of a rubber product need to indicate a type recipe , processes involved to produce the intended product)
2. Able to Use innovative methods for presenting the projects.
3. Record details accurately in an appropriate format
4. Ensure that the final report meets with the requirements of the project completion or make any amendments accordingly
5. Gets hands-on training on the working of the equipments and accessories

Course Content

Student will do Industrial Project in rubber industry on

1. Industrial project in Footwear
2. Industrial Project in Belting Industry
3. Industrial project in Automotive parts manufacturing Industry
4. Industrial Project in Tyre Industry
5. Industrial Project in other rubber product manufacturing industry

Recommended Books:

1. Reverse Engineering of Rubber Products: Concepts, Tools and Techniques (1st Ed.), Saikat Das Gupta, Rabindra Mukhopadhyay, Krishna C. Baranwal, Anil K. Bhowmick, CRC Press, 2013.
2. Rubber Products Manufacturing Technology, (Eds.) Anil K. Bhowmick, Malcom M. Hall, Henry A. Benarey, Marcel Dekker, Inc, New York, 1994.
3. Rubber technology and manufacture, 2nd ed., C. M. Blow and C. Hepburn, Eds., Butterworths, London, 1982.
4. The Complete Book on Rubber Processing and Compounding Technology, NIIR Board Of Consultants, Engineers, Asia Pacific Business Press Inc., 2007.
5. Technology of Rubber and Rubber Goods Industries, Engineers India Research Institute (EIRI), India
- 6.

Report Writing & Presentation

(3+3 Credits)

Skilled Based Education Course Code: RTS-603

COURSE OUTCOMES

1. Able to follow report writing procedures as prescribed by the institutes
2. Able to record details accurately in an appropriate format
3. Understand the importance of complete and accurate documentation
4. Understand the importance of maintaining the security and confidentiality of recorded
5. Able to prepare project report and presentations

Course Content

- ✓ Write a complete report on Industrial Project and make a power point presentation to present in the department for evaluation.
