

**TRIPURA UNIVERSITY**  
**(A Central University)**  
**Suryamaninagar-799022, Tripura**  
**INDIA**

**Skeleton of the Course Curriculum of Bachelor in Vocational Rubber Technology**  
**(B. Voc Rubber Technology)**  
**First Semester (1<sup>st</sup> Semester NSQF level 4)**  
**Job Role: Rubber Technician**

**General Education – 16 Credits**

SL No	Course Code	Course Particulars	Credits
1	BVG-101	<b>Communication Skill</b>	4
2	BVG-102	<b>Basics of Computer: Words – Excel – Power Points – Social sites</b> (Theory and Practical)	4
3	BVG-103	<b>Concept of Business: Banking, Bank Loan, Income Tax, Maintaining of Business Journal, Ledger, Balance Sheet</b>	4
4	RT-101	<b>Basics of Rubber: History, Concept of Rubber Science, Plantation, Different kinds of Rubber industries</b>	4

**Skill Based Education – 14 Credits**

SL No	Course Code	Course Particulars	Credits
1	RTS- 101	<b>Soil Chemistry for Rubber: Theory</b>	2
2	RTS-102	<b>Latex Collection &amp; Preservation: On field training</b>	2+2 = 4
3	RTS-103	<b>Latex Coagulation &amp; Rubber Sheet Preparation: Industry training</b>	2+2 = 4
4	RTS-104	<b>Soil Testing: Lab</b>	4

**Second Semester**  
**Job Role: Rubber Associate**  
**NSQF Level - 5**

**General Education – 8 Credits**

SL No	Course Code	Course Particulars	Credits
1	BVG-201	<b>Entrepreneurship</b>	4
2	RT-201	<b>Latex Compounding: Materials, Methods &amp; Testing Procedure</b>	4

**Skill Based Education – 22 Credits**

SL No	Course Code	Course Particulars	Credits
1	RTS-201	<b>Testing Method: Raw Material/ Finished Product (Industry)</b>	4
2	RTS-202	<b>Latex Compounding Testing: Raw Material / Finished Product</b>	4

3	RTS-203	<b>Latex Product Manufacturing</b>	4
4	RTS-204	<b>Industrial Training: Lab Chemist – Incoming Raw Material/ Finished Product</b>	4
5	RTP-201	<b>Project – I</b>	4
6	RTP-202	<b>Report Writing &amp; Presentation</b>	2

Year: 2: B. VOC in Rubber Technology

Job Rules: Rubber Specialist

NSQF Level – 6

### Third Semester

#### General Education – 16 Credits

SL No	Course Code	Course Particulars	Credits
1	BVG-301	<b>Advanced Communicating English &amp; Soft Skill</b>	4
2	RT-301	<b>Basics of Polymer Chemistry</b>	4
3	RT-302	<b>Basics of Rubber Science and Additives</b>	4
4	RT-303	<b>Statistical Methods</b>	4

#### Skill Based Education – 14 Credits

SL No	Course Code	Course Particulars	Credits
1	BVGS-302	<b>Communication Skill-Lab</b>	2
2	RTS-301	<b>Raw Materials Testing (Additives) - Industry</b>	4
3	RTS-302	<b>Raw Material Rubber Testing: Industry</b>	4
4	RTS-303	<b>Statistical Methods (Practical)</b>	4

### Fourth Semester

#### General Education – 8 Credits

SL No	Course Code	Course Particulars	Credits
1	RT-401	<b>Synthetic Rubber, Blending and manufacturing of Rubber Products</b>	4
2	RT-402	<b>Tyre and Tube production- Theory</b>	4

#### Skill Based Education – 22 Credits

SL No	Course Code	Course Particulars	Credits
1	RTS-401	<b>Latex: Collection, Processing and Storage</b>	4
2	RTS-402	<b>Manufacturing Process: Latex and Rubber Products</b>	3+3= 6
3	RTS-403	<b>Quality check, Problem Identification and Testing</b>	4
4	RTS-404	<b>Concepts of Pricing</b>	4

5	RTS-405	Health and Safety Issues	2
6	RTP-401	Report Writing & Presentation	2

Year: 3: B. VOC in Rubber Technology

Job Rules: Rubber Technologist

NSQF Level – 7

#### Fifth Semester

##### General Education – 16 Credits

SL No	Course Code	Course Particulars	Credits
1	RT-501	Rubber Processing Instruments	4
2	RT-502	Rubber to Metal Bonded Products	4
3	RT-503	Sales & Purchase	4
4	RT-504	Entrepreneurship Skill	4

##### Skill Based Education – 14 Credits

SL No	Course Code	Course Particulars	Credits
1	RTS-501	Mixing of Rubber	2
2	RTS-502	Material handling, weighing and Compounding	4
3	RTS-503	Manufacturing of Rubber Products	4
4	RTS-504	Testing of Rubber Products	4

#### Sixth Semester

##### General Education – 8 Credits

SL No	Course Code	Course Particulars	Credits
1	RT-601	Advanced learning on product manufacturing & Reverse Engineering	4
2	RT-602	Tyre retreading & Reclaiming	4

##### Skill Based Education – 22 Credits

SL No	Course Code	Course Particulars	Credits
1	RTS-601	Quality check: Rubber & Rubber Products	4
2	RTS-602	Industry Project in rubber product manufacturing industry	6+6
3	RTP-601	Report Writing & Presentation	3+3

**DETAILED SYLLABUS**  
**1<sup>st</sup> Semester B. Voc Rubber Technology**  
**General Education**  
**Communication Skill**

**General Education Course Code: BVG-101**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

**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-Stroke-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

**Basics of Computer**  
**General Education Course Code: BVG-102**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

## **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.*]

## **CONCEPT OF BUSINESS**

**General Education Course Code: BVG-103**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

### **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.

# **Basics of Rubber**

**General Education Course Code: RT-101**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

## **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

**SKILL BASED EDUCATION**  
**1<sup>st</sup> Semester B. Voc Rubber Technology**

**Soil Chemistry for Rubber (Theory)**  
**Skilled Based Education Course Code: RTS-101**

**Total Marks: 50 (Theory 35 + Internal Assessment 15)**  
**Credit: 2**

**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

**Latex Collection and Preservation**  
**Skilled Based Education Course Code: RTS-102**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

**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.

## **Latex Coagulation and Rubber Sheet Preparation**

**Skilled Based Education Course Code: RTS-103**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

### **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 – Prevulcanized 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 modifies. Latex products – Dipped latex products, Foamed latex products, Latex casting, Latex spreading.

## **Soil Testing (Lab)**

**Skilled Based Education Course Code: RTS-104**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

- Soil profile study and collection of soil
- Textural analysis of soil
- Soil moisture study
- Soil pH and conductivity
- Soil OC, N, P, K
- Critical values for N, P, K under rubber soils and fertilizer recommendation.

**2<sup>nd</sup> Semester B. Voc Rubber Technology**  
**Latex Compounding: Materials, Methods & Testing Procedure**  
**General Education Course Code: RT-201**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

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

**Entrepreneurship**  
**General Education Course Code BVG-201**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

**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.

## **Skilled Based Education**

### **2<sup>nd</sup> Semester B. Voc Rubber Technology**

#### **Testing Methods: Raw Material/ Finished Product Skilled Based Education Course Code: RTS-201**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

**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

**Latex Compounding and Testing: Theory and Practical**  
**Skilled Based Education Course Code: RTS-202**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

**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

**Latex Product Manufacturing**  
**Skilled Based Education Course Code: RTS-203**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

**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.

**Industrial Training: Lab Chemist – Incoming Raw Material/ Finished Product**  
**Skilled Based Education Course Code: RTS-204**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

- ✓ 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**

**Skilled Based Education Course Code: RTP-201**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

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**

**Skilled Based Education Course Code: RTP-202**

**Total Marks: 50 (Theory 35 + Internal Assessment 15)**

**Credit: 2**

- ✓ 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.

### **3<sup>rd</sup> Semester B. Voc Rubber Technology**

**Advanced Communicating English & Soft Skill**

**General Education Course Code: BVG-301**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

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.

**Basics of Polymer Chemistry**  
**General Education Course Code: RT-301**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

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

Thermoplastic

**Basics of Rubber Science and Additives**  
**General Education Course Code: RT-302**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

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.

### **Statistical Methods**

#### **General Education Course Code RT-303**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

#### **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.

### **Skill Based Education**

**Communication Skill-Lab**  
**Skilled Based Education Course Code: BVGS-301**  
**Total Marks: 50 (Theory 35 + Internal Assessment 15)**  
**Credit: 4**

**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.

**Raw Materials Testing (Additives): Industry**  
**Skilled Based Education Course Code: RTS-301**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

**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,

**Raw Material Rubber Testing**  
**Skilled Based Education Course Code: RTS-302**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**



**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.

**Statistical Methods (Practical)**

**Skilled Based Education Course Code: RTS-303**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

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

**4<sup>th</sup> Semester B. Voc Rubber Technology**

**Synthetic Rubber and Blending**

**General Education Course Code: RT-401**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

**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, fluoro carbon, polyurethane rubbers, polypropylene oxide, polyethers, polyalkylenes. 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.

Calendering 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

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

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

**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 process; process of valve application.

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

**Skill Based Education**

**Latex: Collection, Processing and Storage**

**Skilled Based Education Course Code: RTS-401**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

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.

**Manufacturing Process: Latex and Rubber Products**  
**Skilled Based Education Course Code: RTS-402**  
**Total Marks: 150 (Theory 105 + Internal Assessment 45)**  
**Credit: 6**

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

**Quality check, Problem Identification and Testing**  
**Skilled Based Education Course Code: RTS-403**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

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.

**Concepts of Pricing**  
**Skilled Based Education Course Code: RTS-404**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

**Health and Safety Issues of Rubber Industries**  
**Skilled Based Education Course Code: RTS-405**  
**Total Marks: 50 (Theory 35 + Internal Assessment 15)**  
**Credit: 2**

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.

**Report Writing & Presentation**  
**Skilled Based Education Course Code: RTP-401**  
**Total Marks: 50 (Theory 35 + Internal Assessment 15)**  
**Credit: 2**

- ✓ 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.

**5<sup>th</sup> Semester B. Voc Rubber Technology**  
**Rubber Processing Instruments**  
**General Education Course Code: RT-501**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

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).

**Rubber to Metal Bonded Products**  
**General Education Course Code: RT-502**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

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.

**5<sup>th</sup> Semester B. Voc Rubber Technology**  
**Skill Based Education**

### **Mixing of Rubber**

**Skilled Based Education Course Code: RTS-501**

**Total Marks: 50 (Theory 35 + Internal Assessment 15)**

**Credit: 2**

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.

### **Material handling, weighing and compounding**

**Skilled Based Education Course Code: RTS-502**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

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.

### **Manufacturing of Rubber Products**

**Skilled Based Education Course Code: RTS-503**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

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, gridding, other methods, halogenations.

### **Testing of Rubber Products**

**Skilled Based Education Course Code: RTS-504**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

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.

**6<sup>th</sup> Semester B. Voc Rubber Technology**  
**Advanced learning on product manufacturing & Reverse Engineering**

**General Education Course Code: RT-601**

**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

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.

**Tyre retreading & Reclaiming**  
**General Education Course Code: RT-602**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**  
**Credit: 4**

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.

**6<sup>th</sup> Semester B. Voc Rubber Technology**  
**Skill Based Education**  
**Quality Check: Rubber & Rubber Products**  
**Skilled Based Education Course Code: RTS-601**  
**Total Marks: 100 (Theory 70 + Internal Assessment 30)**

**Credit: 4**

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,

### **Industrial Project-I & II**

**Skilled Based Education Course Code: RTS-602**

**Total Marks: 300 (Theory 210 + Internal Assessment 90)**

**Credit: 6 + 6 = 12**

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

### **Report Writing & Presentation**

(3+3 Credits)

**Skilled Based Education Course Code: RTS-603**

**Total Marks: 150 (Theory 105 + Internal Assessment 45)**

**Credit: 3 + 3 = 6**

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