PART-II

This is an open book breadth and depth examination, comprising 60 Multiple Choice Questions (MCQs) of one mark each (total 60 marks) with a duration of three hours. There shall be two sections of Part-II for each major discipline of EPE. Qualifying Marks for this part shall be sixty per cent.

SECTION-A / BREADTH

This section will generally confirm to latest (updated) B.E./equivalent qualification of Textile Engineering. The examination of this section shall comprise 25 MCQs (total 25 marks).

1. Mathematics for Engineers 10 %
   i. Engineering Functions, Derivatives and their Application, Integration and its Application, Transcendental Functions, Multivariable Functions and Partial Derivatives, Infinite Series
   ii. First, second, and higher Orders Differential Equations, Series Solution of Differential Equations, Special Functions, System of Differential Equations, Laplace Transforms

Suggested Books

- Calculus and Analytic Geometry by George B. Thomas and Ross L. Finney, 2002
2. Statistics for Engineers 6%

i. Statistical Method
Fundamentals of Statistics, Types of variables, Measurement scales, Description of data tables and graphs, Stem and leaf plot, Box plot, dot diagram, Measures of central tendency, Measures of variability, Moments and Moment ratios, Coefficient of Kurtosis and Skewness, Chebyshev inequality and its application.

ii. Regression & Correlation
Introduction to regression and correlation, experimental and non-experimental data, scatter diagram, Estimation of parameters in simple linear regression by least squares method, Properties of least squares regression, prediction in SLR, Coefficient of determination, Multiple linear regression, Polynomial regression, Prediction in MLR, Simple, partial and multiple linear correlation coefficients and their properties.

iii. Probability and Distribution Theory
Introduction to probability and axioms of probability, Rules of counting, Basic laws of probability with proofs, Conditional probability, Discrete and continuous random variables, Mathematical expectation and its properties, Marginal and conditional distributions, Discrete probability distributions; Uniform, Bernoulli, Binomial, Hypergeometric, Poisson, Continuous probability distributions; Normal.

iv. Sampling & Sampling Distributions
Basic Definitions, Advantages of Sampling, Probability and Non-probability sampling, Sampling and non-sampling errors, Sampling distributions of sample mean, difference between means, proportion, difference between proportions, and variance with their properties, Concept of standard normal, student’s t, $\chi^2$ and F-distributions and their relations.

v. Estimation & Hypothesis Testing
Introduction to statistical inference, Estimate, Estimators and their properties. Testing of hypothesis and interval estimation for population mean, difference between two population means, population proportion, difference between two population proportions, population and variance. Definition of P-value. Determination of sample size. Power of the test. Goodness of fit tests, test for independence in contingency table, test for equality of several proportions.

Suggested Books:
3. Physics  

i. Classical Mechanics:  
Physical quantities and Vectors, Newton’s laws and their applications  
Work, kinetic energy and Work energy theorem, Gravitational potential  
energy, elastic potential energy, conservative forces, Rotational  
motion about a fixed axis, dynamics of systems of particles,  
momentum, moment of inertia, Equilibrium, stress, strain, elastic  
modulus, elasticity & plasticity,  

ii. Waves and Oscillation:  
Simple Harmonic Oscillations, Forced Oscillation and Damped  
oscillation, Longitudinal and transverse waves, The wave equation,  
The principle of superposition for waves, Standing waves, Sound,  
Interference, Doppler’s effect  

iii. Electricity and Magnetism:  
Fundamental concepts, Coulomb’s law, Gauss’s law and applications,  
Electric Potential, Equipotential surfaces, Capacitance, dielectrics,  
Motion of charged particles in magnetic field, Ampere’s law, faraday’s  
law & applications, Maxwell’s equations, eddy currents,  
electromagnetic induction
iv. **AC fundamentals:**
   Fundamentals of AC, behavior of currents and voltage across resistors, inductors and capacitors, measurement of power

v. **Electronics:**
   Semiconductors, diodes, transistors and their applications, Oscillators, transducers

vi. **Optics:**
   Nature of light, reflection, refraction, total internal reflection, Dispersion, polarization, scattering, Huygens's principle, Interference in thin films, Michelson's interferometer, Fresnel and Fraunhofer Diffraction, Multiple slits, X-rays diffraction, holography

**Suggested Books:**

- “University Physics” by Young, Freedman 12th Edition
- “Physics” by Halliday, Resnic, Krane 4th Edition
- “Electronic Devices” by Floyd 8th Edition

4. **Chemistry** 10 %

i. Fundamentals of Chemical Equilibria and Chemical Kinetics

ii. Physical Properties of liquids, their measurement & applications

iii. Surface Chemistry

iv. Fundamentals Organic Chemistry and Aromatic Hydrocarbons

v. Fats, Oils, Acids, Bases, Oxidizing and Reducing Agents, Solutions and their properties

vi. Water and its properties

**Suggested Books**

- Physical Chemistry by Dr.G.Nabi
- Physical Chemistry by Dr.Ghulam Rasool Ch.
- Essentials of Physical Chemistry by B.S.Bhal
- A Textbook of Physical Chemistry by S.Glasstone
- A Textbook in Engineering Chemistry by S.S.Dara
5. Computer for Engineers  6%

i. Computer hardware, Input devices, Output devices, Operating systems

ii. Introduction to programming, Documentation and styles, Appropriate use of controlled structure, Data types and sub programs, Data abstraction and verification.

iii. Hands on experience of current available softwares being used in all sub sectors of textile industry e.g. Gerber Clothing Technology, CAD/CAM/ERP, MATLAB, LABVIEW.

Suggested Books

- Discovering Computers by Shelly, Casbman, Waggoner
- Introduction to Computers by Peter Norton 2004
- How Computer Work by Rou White and Timothy Edward Donns, 2005
- Beginner’s Programming for Dummies by Wallace Wang, 2006
- You can do it!: A Beginner’s Introduction to Computer Programming by Francis Glassborow, 2004
- Learn to Program (Pragmatic Programrs) by Chris Pine, 2006
- How Computer Programming Works by Dan Appleman, 2000

6. Fiber Science  10%

i. Fundamentals and Fine structure of fiber

- Nature of matter, Intermediate bonds, Nature of fibers, Methods of investigation of fiber structure, Crystalline and non-crystalline regions, fringed fibers structure, Fine structure of important natural and man-made textile fibers

ii. Moisture and textile fibers
Equilibrium absorption of water, heat of sorption, rate of absorption of moisture, Retention of water, Swelling, Theories of moisture sorption

iii. Electric properties
   - Dielectric properties, Electrical resistance, Static electricity

iv. Optical Properties
   - Refractive index and birefringence, Measurement of refractive indices, Absorption and Dichroism, Reflection and luster

v. Thermal Properties
   - Thermal parameters, thermal expansion and contraction, Structural changes in fibers on heating, Melting, Setting.

Suggested Books:

7. Textile Raw Materials
   i. Classifications of textile fibers
   ii. Production, properties and applications of natural fibers
   iii. Production, properties and applications of conventional man-made fibers
   iv. Properties and applications of high performance fibers

Suggested Books:
   - Man-mad Fibres by R.W Moncrieff, 1975
   - Man-made Fibres and Processing by Kelvin W, 1994
8. **Mechanics of Fibrous Structures**  
   10%
   
   i. Fundamentals of Mechanics of Materials  
   
   ii. Tensile Behavior of Textile Materials  
   
   iii. Plasticity of Textile Materials  
   
   iv. Modeling of Textile Materials  
      Translation of Mechanical Properties of Fibres into Yarn, and Yarn into Fabric.
   
   v. Fabric Hand and Drape Evaluation  
      - Fabric stiffness, wrinkling, and crease resistance  
   
   vi. Compression of Textile Materials  
      - Study of Resilience, Friction between Single Fibres, Friction in Plied Yarns

Suggested Books:

- Textiles Research Journals  
- Plastics (Materials and processing) by Brent Strong 2006  
- Mechanical Behavior of Materials by Thormen H Courty 1990  
- Structure & Mechanics of Textile Assembles by P Schwartz
• Structural Mechanics of Fibres Yarn and Fabric by JWS Hearle, 1969
• Physical Properties of Textile Fibres by WE Molton, 1997
• Mechanics for Textile Student by WA Hanton, 1960

9. **Color Science**

    7%

  i. **Light and Color**
    - Types and sources of light, electromagnetic spectrum.
  
  ii. **Human Eye**
    - Structure of human eye, theories of color vision.
  
  iii. **Color Mixing and Matching**
    - Additive color mixing, subtractive color mixing, chromatic effects,
      Visual color matching, color matching booths,
      Spectrophotometer, Kubelka-Munk theory of color matching,
      computer color matching, prediction and limitations.
  
  v. **Color Specification Systems and Measurement**
    - Color order systems and their types, CIE Systems, computation
      of tri-stimulus values, visual and instrumental evaluation of
      whiteness and yellowness, whiteness and yellowness index,
      traditional whiteness formulae, Berger formula, hunter formula,
      application in textile industry
  
  vii. **Color Difference Measurements and Color Constancy**
    - Color differences, Metamerism and its types, Instrumental color
      assessment, color difference equations and measurements, pass
      fail standards.

**Suggested Books:**

- Color Measurement (Principles, advances and industrial Applications),
  By: M. L. Gulrajani
- Color Physics for industry, By: Roderck Mc Donald
- Color Vision and Technology, By: Rolf G. Kuehni
10. **Textile Engineering Utilities**  

i. Compressors, air conditioners, humidifiers  
ii. Electrical motors, electronic control and automation systems, and Industrial lighting  
iii. Steam generation and transportation systems  
iv. Water and energy conservation in textile industry  
v. Basic concepts of energy generation resources  

**Suggested Books:**  
- Air-conditioning in Textile Mills by S. P. Patel, ATIRA silver jubilee monographs, 1974  

11. **Environmental Issues**  

i. Textile & Environment  
   - Air, water and noise pollution, effect of textile industry on environment  
ii. Environmental Management Systems  
   - ISO 14000, National Environmental Quality Standards  
iii. Eco-labelling  
   - Oeko-tex-100, EU eco-label  
iv. Cleaner Production Technologies in Textile Industry  
   - Reduction and control of pollution in textile industry, Environmental impact assessment an audits  
v. Safety Concepts and Standards in Textile Industry  

**Suggested Books:**  
- Padma Vankar (2002), Textiles effluent, NCUTE Publications, IIT, Delhi
- Eco friendly processing- NCUTE Publications.
- Environmental problems in chemical processing of textiles- NCUTE Publications.
  Waste water.
- An introduction to environmental pollution by Dr. B.K. Sharma. Environmental Impact of Textiles, BY: K Slater
PART-II

SECTION-B / DEPTH

This section shall be based on practical concepts framed to judge the practical experience and field based knowledge of Registered Engineers (REs). The examination of this section shall comprise 35 MCQs. Each candidate may attempt the only opted area of practice, among the followings.

1. YARN MANUFACTURING

   i. Classification of yarn manufacturing techniques
      • Short and long staple spinning systems
      • Filament yarn manufacturing systems

   ii. Spinning Processes
      • Staple spinning processes
      • Modern staple spinning technologies

   iii. Blow Room and Carding
      • Working principles of intermediate processes in blow room
      • Objectives of carding, carding actions, working of card, role of different parts and their speeds.

   iv. Drawing
      • Concept of drafting, Real and perfect drafting, Draft calculation and system, Drafting and doubling, Objectives and working of drawing frame, Breaker, inter and finisher drawing frame.

   v. Combing
      • Objectives of combing, Combing preparatory processes, Study of comber.

   vi. Roving
      • Objectives of roving frame, Winding principles, Working of roving frame, Why and how twist is imparted in roving.

   vii. Ring Spinning
      • Objectives of ring spinning, Principle and mechanism of twist insertion, Working of ring frame
viii. Woolen Industry

ix. Worsted Industry
- Worsted carding, backwashing, gilling, combing, drawing and spinning.

x. Winding and Yarn Packing
- Objectives of winding, types of packages and windings, types of winders, splicing and yarn clearing.

**Suggested Books:**
- Manual of Cotton Spinning by Gilbert R. Merrill, 1960
- Spun Yarn Technology by Eric Oxtoby, 1987
- The Woolen & Worsted Industry by Brearley and Iredale, 1980
- W. Klein “Short Staple Spinning” (vol-I) (1998)

2. FABRIC MANUFACTURING
i. Warping and its objectives
- Yarn Packages, warping types, comparison of warping processes

ii. Sizing and its objectives
- size types and recipes, detailed study of sizing machines

iii. Drawing-in and Knotting Techniques

iv. Basic Weaving Mechanisms

v. Conventional and Advanced Weft Insertion Methods

vi. Basic and Advanced Woven Fabric Structures and their Manufacturing Techniques
vii. Knitted Fabric Structures, Classification of Knitting Machines, Weft and Warp Knitting

viii. Properties and Usage of Weft and Warp Knitted Fabrics.

Suggested Books:
- Manual of Cotton Spinning by Gilbert R. Merrill, 1960
- Spun Yarn Technology by Eric Oxtoby, 1987
- The Woolen & Worsted Industry by Brearley and Iredale, 1980
- W. Klein “Short Staple Spinning” (vol-I) (1998)
- Sabit Adanur “Handbook of weaving” 2001
- Dr. M. Talukdar “Weaving, Mechanisms and Management” 1998

3. TEXTILE PROCESSING

i. Singeing and Shearing
   - Singeing and shearing, Shearing machine and its description, Singeing techniques (plate, roller, gas), Gas singeing positions, Gas singeing parameters, Gas singeing machine parts function, Singed fabric evaluation and testing, plate singeing process and parameters.

ii. Desizing
   - Sizing of cotton, types and chemical composition of sizing material, desizing techniques, advantages and disadvantages of desizing, effect of time, temperature, concentration, electrolytes and Ph on enzymes, acid and oxidative desizing techniques, testing and evaluation of desized fabric
iii. Scouring and Bleaching
- Scouring chemicals, auxiliaries and processes, scouring of natural and synthetic materials, standard testing and evaluation of scoured fabrics
- Principle and objectives of bleaching, bleaching chemicals, auxiliaries and techniques, chlorine and peroxide bleaching mechanism, advantages and disadvantages of chlorine and peroxide bleaches, exhaust and continuous bleaching principle, machine and methods, standard testing and evaluation of bleached fabrics.

iv. Mercerizing and Caustisizing
- Mercerizing and Caustisizing process and its objectives, effect of mercerization on cotton fiber, type of mercerizing methods (chain, chainless, slack and hot mercerizing), neutralization of mercerized fabrics, quality parameters of mercerizing process, testing and evaluation techniques of mercerized fabrics (barium activity number).

v. Cellulosic Dyeing
- Direct, reactive, vat and sulphur dyes, structure and classification, chemistry, theory, application, principle and methods, wash fastness improvement of direct dyes (diazotization, cationization, copper and formaldehyde after treatment), effect of electrolytes, alkalis, acids and bleaching agents on reactive dyeing, bronzing and tendering effect and method of sulphur dyeing, fastness properties of vat dyes and premature oxidation and its effect on dyeing.

vi. Disperse Dyeing
- Disperse dyes, structure and classification, chemistry and theory of dyeing, dyeing and fixing mechanism, temperature and pH effects, carrier dyeing method, limitations of carrier dyeing method, high temperature method of polyester dyeing,
advantages of high temperature dyeing, high temperature method with carriers, thermosole dyeing method, testing and evaluation of disperse dyed fabrics.

vii. Dyeing of Wool, Silk and Acrylic

- Chemistry and theory of acid/basic dyeing, dyeing and fixation mechanism, wool, silk and acrylic dyeing using acid/basic dyes, temperature and pH effects on acid dyeing, role and chemistry of retarding agents, testing and evaluation of dyed fabrics.

viii. Design, Engraving and Printing

- Function/importance of design studio, methods involved in engraving, history of pigment printing, pigments and pigments properties, difference between dyes & pigments, application of pigments on cotton, role and brief chemistry of auxiliaries/binders used during pigment printing, advantages and disadvantages of pigment printing
- Reactive printing of cotton fibers, dye selection criteria, fixing mechanism, print paste formulation for reactive printing, print paste formulation for pigment printing.

ix. Finishing

- Sanforizing, emerizing, calendaring, raising.
- Water, soil and oil repellency, flame retardancy/resistancy, anti-static finishing, antimicrobial finishing.

**Suggested Books:**

- Chemistry & Technology of Fabric Preparation & Finishing, Dr. Charles Tomasino, Department of textile engineering, chemistry and science college of textiles, North Carolina state university
- Color Vision and Technology, By AATCC
4. **GARMENT MANUFACTURING**

i. **Apparel Design and Development Concept**
   - Design Elements, Design Principles, Pre-adoption Phase, Line-adoption Phase, Post adoption Phase, garment sample types, garment sample development

ii. **Pattern Making, Marker Making and Cutting**
   - Concepts and pattern making, dimensions of marker, marker efficiency and quality, fabric spreading and cutting, manual and mechanized cutting types

iii. **Stitches and Seams**
   - Stitch formation (L/S, C/S, O/L, F/L), seam types and application areas

iv. **Sewing Threads**
   - Types, manufacturing, properties and applications

v. **Sewing Machine Fundamentals**
   - Sewing needles, bobbins, cases and hooks, looper, spreader, throat plates, tongues, chaining devices, lubricating systems and casting of main body

vi. **Material Handling Systems**
   - Progressive Bundle System (PBS), Unit Production System (UPS), Modular Production System (MPS)

vii. **Technology Advancement**
viii. Apparel Accessories & Work Aids
   - Apparel Support Materials: Interlinings, Linings, Other Support Materials (Adhesives, Collar Stays, Shoulder Pads, etc)
   - Trims: Embroidery, Applique, Laces, Knit Trims, Screen Prints, Heat Transfer, Prints, Labels
   - Closures: Types of Closures, Zipper, Parts of a Zipper, Button & Buttonhole, Button Sizes
   - Work Aids/Attachments: purpose, common types of attachments

ix. Garment Finishing & Packing
   - Garment finishing, special treatments, stain removing, garment wet processing, seam quality defects
   - Purpose, elements of pressing, types of pressing, pressing operations, pressing techniques, pressing equipments
   - Different types of packing materials, packing styles, types of containers.

x. Quality Control in Apparel
   - Process flow of Quality Department, Quality Control & Quality Assurance, How to Control Quality, DHU-Defects per Hundred Units, AQL-Acceptable Quality Level, Quality Zones in Garments

Suggested Books:
3. Applied knowledge of Sewing, Juki Corporation (Pub.)
4. Fashion from concept to consumer, Frings, Gini Stephens Prentice Hall, 1999